

Fortress

Defenses of Pearl Harbor and Oahu 1907–50

G Williford & T McGovern • Illustrated by C Taylor

Fortress • 8



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Authors' note

The following abbreviations appear in the photographic captions in this book.

AM: US Army Museum of Hawaii, Honolulu, Hawaii
GW: Glen Williford Collection
NARA: National Archives and Records Administration, Washington, DC
TM: Terrance McGovern Collection
UM: University of Hawaii, Honolulu, Hawaii

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Introduction

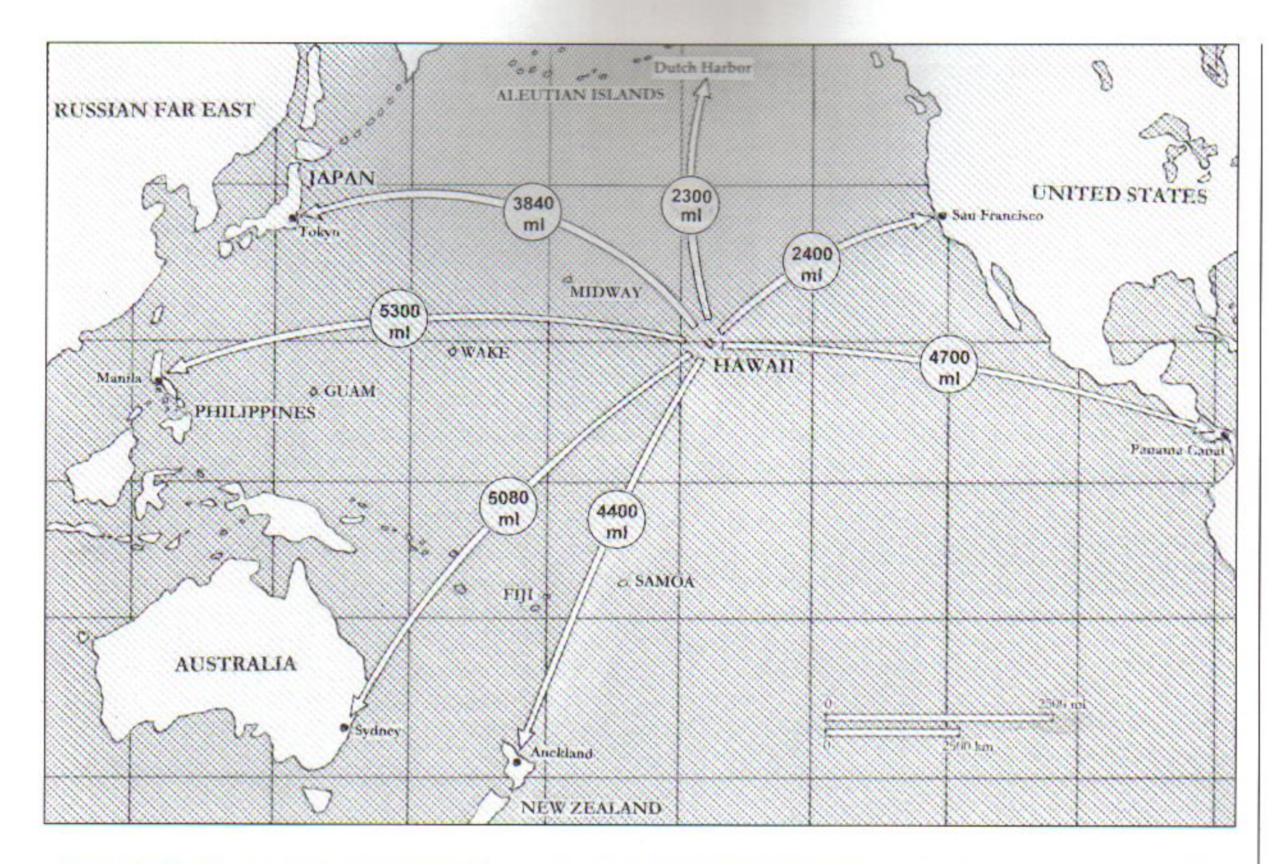
Most of us associate the words "Pearl Harbor" with the surprise Japanese air raid on the home of the US Pacific Fleet on the morning of December 7, 1941. We may also recall that the attack resulted in many American casualties (2,388 dead and 1,109 wounded) and that most of the battleships berthed at the Pearl Harbor Naval Station that day were either sunk or badly damaged, propelling the United States into World War II. Yet few of us will pause to consider why the US Pacific Fleet was based on Oahu in the Hawaiian Islands and what efforts were undertaken by the US Army to defend Pearl Harbor from attack. The fact that America's military involvement in Hawaii began with the Spanish American War in 1898, and that the Army had been developing defenses on Oahu for more than 30 years before the attack, are often neglected. This study aims to tell the story of "Fortress Oahu" and its defenses, from their inception in 1907 to their dismantling in 1950.This book will also assist today's intrepid explorer in visiting many of the works discussed. Fortifications survive over time better than most other military legacies, no doubt because of their inherent massive construction: this is also true on Oahu, for most of the works discussed in this book still exist and can be visited.

The Hawaiian Islands occupy an important strategic position for the defense of American interests in the Eastern Pacific Ocean and the West Coast of North America. By developing military bases in Hawaii, Alaska, and the Panama Canal vicinity, a defensive border thousands of miles from the population centers on the West Coast could be maintained. Given the vast expanse of the Pacific Ocean, maintaining a naval force was paramount. Such a force required repairs and supplies on a constant basis so without a nearby support base these naval assets would be unable to maintain the defensive perimeter. The island of Oahu offered the best natural port in the Hawaiian Islands and once the US Navy committed to establishing a major base there, the Army was assigned and energetically undertook the mission to defend this against all known threats.

The Army's mission to ensure the safety of the military assets in Hawaii was a "moving target" though. The number of threats grew as military technology



Oahu owes its numerous craters to its volcanic origins. Although they created terrain that was difficult to negotiate during construction, this contributed to the island's defensive strength, and being made of relatively soft rock they were easy to tunnel through. Diamond Head on southeastern Oahu is perhaps the most recognizable feature. This 1994 aerial view shows the 764ft-high Leahi Peak and the coastal road skirting the crater's base. The two casemates for a 1940s 8in. battery can be seen on the outer left side of the crater. (TM)



advanced rapidly in the interwar years and the scope of the defenses increased. At first the Army could concentrate its efforts on defending the ports of Honolulu and Pearl Harbor from naval bombardment. Before long, the Army had to deal with new types of warship and the advent of military aviation. These developments resulted in new defensive works being built and more military resources allocated to protect all of Oahu while responding to possible air raids, underwater attacks, naval bombardments, amphibious landings, and sabotage. These technological advances and novel tactics coincided with the rise of Japan as a Pacific military power with the resources to carry out such attacks on Oahu. The result was that America built an island fortress with sophisticated artillery defenses, multiple airfields, underground command centers, beach defenses, mobile troop formations, and large supply centers designed to provide the Navy with a protected naval station to support the US Pacific Fleet.

Located in the east-central Pacific Ocean, the Hawaiian Islands are strategically and physically isolated. This map shows the relative distances in miles from Oahu to major Pacific Rim ports and locations.

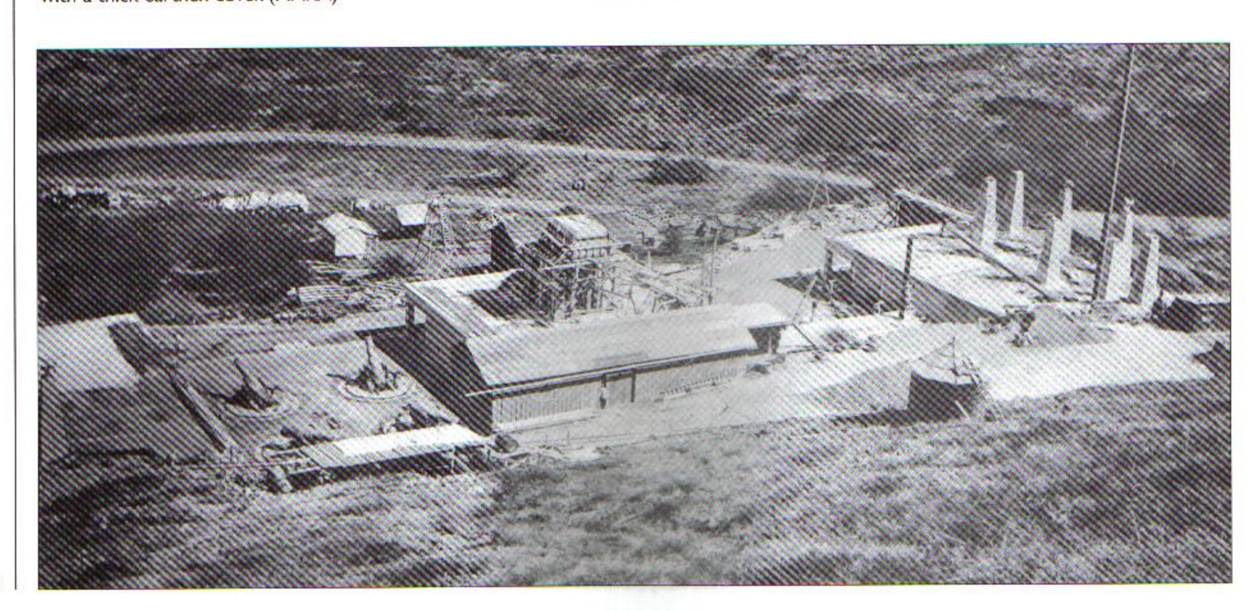
On December 7, 1941 these defensive efforts were tested. The political, strategic, and tactical doctrines of the United States and Japan crossed paths at this time and place. While the Americans thought themselves adequately prepared against all potential threats, events proved otherwise. Their ability to detect and defend against the Japanese air raid delivered was woefully inadequate. The sinking of key American battleships within the supposedly "protected" environs of Pearl Harbor was a significant failure on their part. Any discussion of the defenses of Fortress Oahu must include the story of this military failure – and while the attack on Pearl Harbor is not the subject of this work, the preparations to meet such an attack and the reaction to it are integral parts of this. For seven years after this, beyond even the end of the war, the fruit of the hard lessons learned manifested itself in the increased pace of construction of Oahu's defenses. By the time of the Japanese surrender in September 1945, this small island was arguably the most heavily defended place in the world (at least in terms of seacoast artillery).

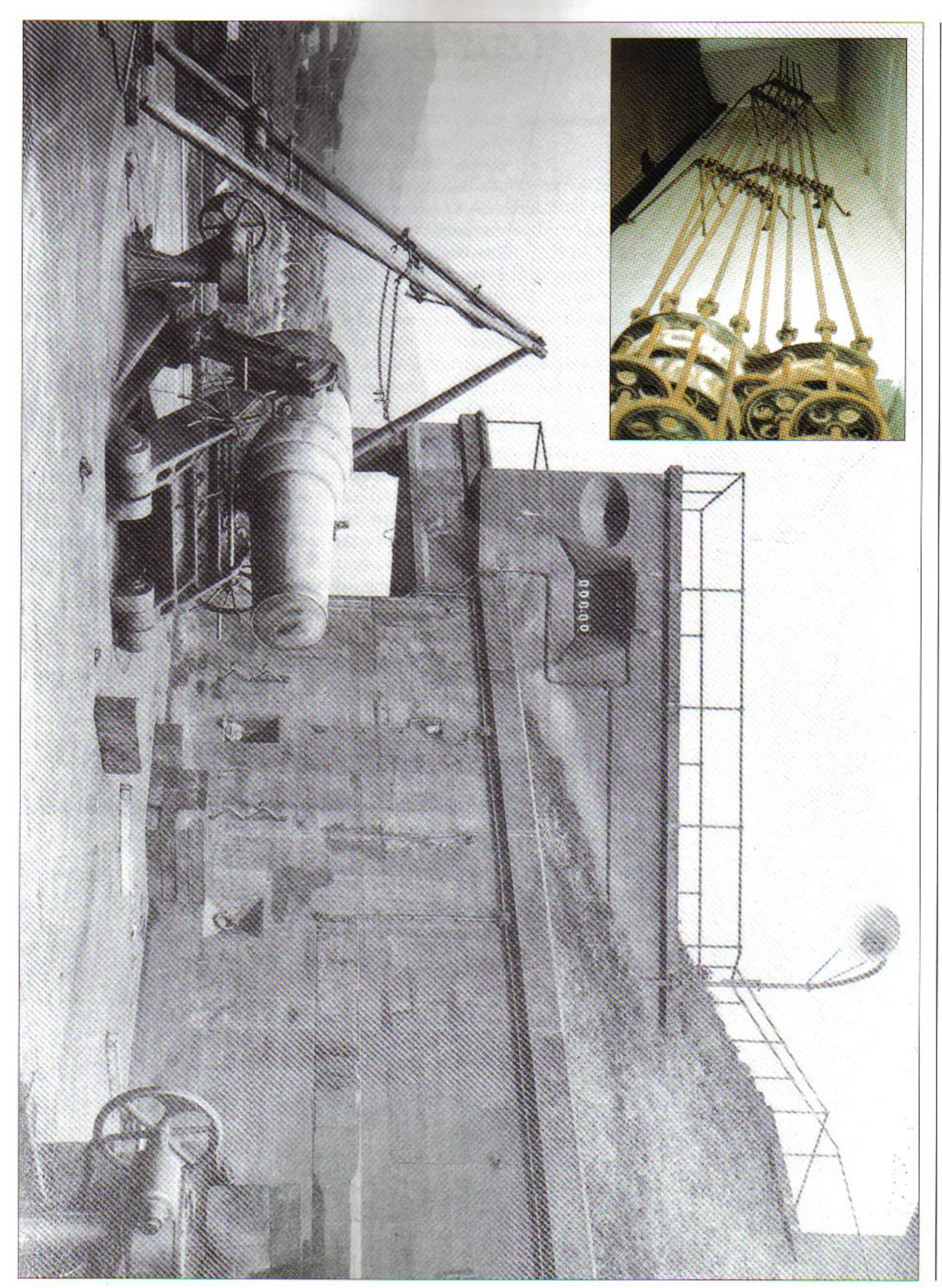
Chronology

OPPOSITE A range indicator booth overlooking Pit A at the 12in. mortar Battery Harlow, Fort Ruger. The battery's plotting room would calculate range and direction based on the observations from the battery's fire control stations. This information would then be passed to the gun crews via the number display mechanism, to allow proper setting of the mortar's azimuth, elevation, and propellant charge. The inset shows part of the indicator's revolving number discs and operating rods inside the booth. (Main image courtesy NARA, inset GW)

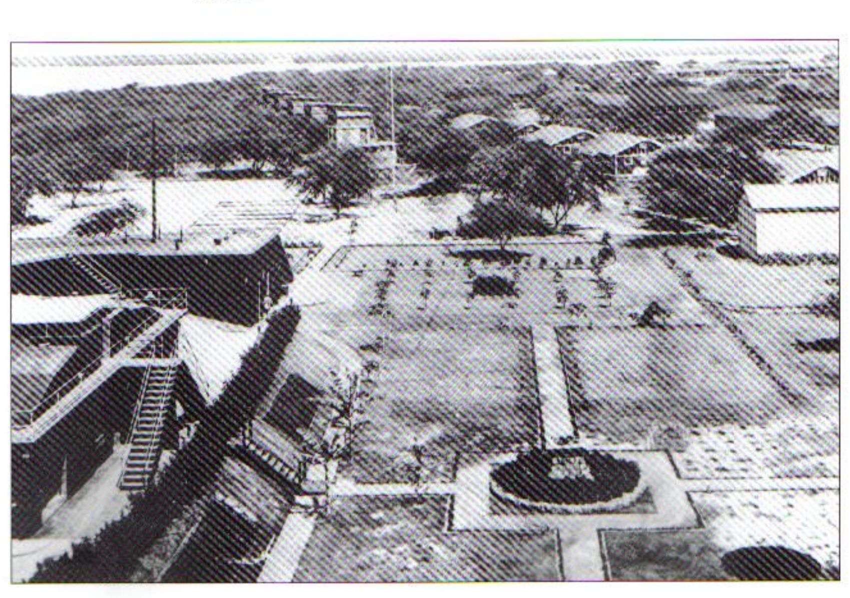
BELOW Most of the construction work for the initial fortifications on Oahu took place between 1907 and 1910. This picture taken February 10, 1909 shows mortar Battery Harlow at Fort Ruger late in an advanced stage of its construction. The principal concrete work appears complete, and the four mortars on the left are already in their pit. Concrete forms for cement pouring can be seen around the battery commander's station on the central traverse. The battery will be finished with a thick earthen cover. (NARA)

1887 July	An extension of the Hawaiian–US Reciprocity Treaty cedes coaling rights in Pearl Harbor.
1899 November	Honolulu is designated a Naval Station.
1901 March	Congress appropriates $150,000 for dredging Oahu's harbors.
1908 May	Congress acts on the Dewey Board Report to make Pearl Harbor a major naval base.
1908 July	The American "Great White Fleet" visits Honolulu.
1908 November	Major E.E. Winslow, chief architect of the initial Oahu defenses, arrives in Honolulu.
1910 March	Battery Harlow at Fort Ruger is completed – the first permanent battery of the Oahu defenses.
1911 January	USS *Petrel* becomes the first American warship to enter Pearl Harbor.
1913 January	The major contingent of permanent US Army troops (coast artillery, infantry, and cavalry) arrives in Oahu by convoy.
1913 May	The mine defenses for Honolulu and Pearl Harbor are completed with the arrival of the Army mine planter *Samuel Ringgold*.
1913 October	Battery Randolph is completed, the largest gun battery of the initial defenses (14in. guns).
1914 November	Battery Hasbrouck is completed – the last permanent battery of the initial coast defense project.
1915 November	The report of the Board of Review recommends new long-range guns for the Oahu defenses.
1916	Completion of the initial construction period for post buildings at the US Army coast artillery and mobile unit forts (Armstrong, DeRussey, Kamehameha, Ruger, Shafter, and Schofield Barracks.)
April	The 14th Naval District is created at Pearl Harbor.
1917 February	Arrival of the 6th Aero Squadron – the first regular air unit stationed in Hawaii.
1919	The US Navy decides to turn Pearl Harbor into a first-class base for fleet units.





1920 May	Completion of the long-range Battery Closson at Fort Kamehameha.
1921	Railway and mobile coast artillery units arrive on Oahu. Formation of the Hawaiian Division.
1923	Navy designates Ford Island as one of its first seven air stations.
1924 September	Battery Williston, with its long-range 16in. guns, is completed.
1933	The US Army funds the construction of the Aliamanu Crater complex with National Recovery Act money.
1934	The Lualualei Naval Magazine is opened, a major new facility for ammunition storage 15 miles northwest of Pearl Harbor.
1935 July	Completion of the 16in.-gun Battery Hatch.
1940 April	The American battle fleet is stationed at Pearl Harbor.
1941 March	The Martin–Bellinger Agreement assigns responsibility for long-range air patrols to the Navy.
April	Approval for the project to fortify the defenses of Kaneohe Bay is granted.
September	Arrival of the first land-based radar sets on Oahu.
October	Growth in mobile ground forces results in splitting the Hawaiian Division into the 24th and 25th divisions.
November	A war warning from Washington results in heightened sabotage alert.
December	Japan attacks Pearl Harbor and Oahu's air stations.
1942 January	The Army receives emergency 5in. and 7in. guns from the Navy, and is offered 8in. mounts from aircraft carriers and two 14in. turrets from the battleship USS *Arizona*.
March	The 27th Infantry Division arrives on Oahu to reinforce mobile forces.
August	The first of the ex-naval turret batteries is completed.
1943 October	The War Department approves the modernization of Oahu's secondary armament (batteries 303, 304, 305, and 407).
1945	The older, original armament is removed and the batteries decommissioned.
June	A post-war study is concluded, which cancels most of the incomplete defensive work.
July	Battery Pennsylvania is proof fired, the last fixed-gun emplacement completed on the island. The work on Battery Arizona is suspended.
1948	All armament except the largest permanent batteries is removed from Oahu.
1950	All the fixed seacoast guns are scrapped. Only some anti-aircraft guns remain.



At times it was difficult to separate the gun batteries and support structures from the post cantonment buildings. This World War I view of Fort Kamehameha shows 6in. Battery Jackson on the left, a series of five fire-control towers in the upper left center, and a host of quarters and post buildings on the right. (AM)

Hawaii and its history

The Hawaiian volcanic islands lie 2,400 miles to the southwest of the US mainland, with nothing between except ocean. The island chain itself runs for over 1,500 miles roughly from northwest (Midway Island) to southeast (Hawaii): there are seven major islands among the 132 permanent islands. They are among the most isolated inhabited places on the planet: there are no close continents, nor are there significant islands nearby. The lack of other islands or harbors in the Eastern Pacific made the Hawaiian Islands, particularly Oahu, strategically important for early maritime and air transit. Oahu is the third-largest island, but the only one having a significant natural harbor. Located on the southern coast of Oahu is the Pearl Harbor lagoon, sheltering over 10 square miles of anchorage. The entrances to the harbor and adjacent Honolulu harbor were originally obstructed by coral reefs, restricting access to only shallow draft vessels.

The natural features of Oahu were important to its military defenses. Two large parallel mountain ranges – the Koolau Range in the east and the Waianae Range in the west – protect a large natural valley in the center of the island. They also offer excellent defensive lines to stop invading armies accessing either of these shores. These features, along with the prevailing weather and sea conditions on the north shore, and the location of the only good harbors and population center on the south shore, greatly simplified the initial defensive plans. The southern shore of Oahu was the obvious place to defend – at least when bombardment or amphibious landing was the only potential threat of any great concern. The soft

One of Battery Randolph's 14in. guns firing a practice round at Fort DeRussy. The shell has just left the muzzle and the barrel is descending from the firing to the loading position. A gun section (42 enlisted men), consisting of a gun and ammunition detachment, manned each emplacement. The gun detachment (29 men) shown here is made up of a gun commander, gun pointer, the chief of the breech, the range setter, the range recorder, the deflection recorder, and 23 cannoneers. (AM)





Oahu's natural form derives from the rims of two ancient volcanoes, the remains of which are the extensive mountain ranges in the west (Waianae) and east (Koolau), with a flat central plain in between them. Only on the south shore do natural harbors exist, at Pearl Harbor and Honolulu.

volcanic rock of the island and its rugged topography facilitated widespread tunneling for gun batteries and other defensive structures.

Indigenous Polynesian people have inhabited the Hawaiian Islands for centuries. Europeans first visited the islands in 1778 when the British Captain James Cook arrived. Unlike many other oceanic locations, the islands were not claimed or developed by colonial powers, and thus no major colonial fortifications were ever built here. Development of economic interests occurred in the 19th century, primarily by immigrant American businessmen. In 1876, the independent Kingdom of Hawaii signed a reciprocity treaty with the United States, ceding Pearl Harbor as a coaling base to the US in exchange for duty-free exportation of raw sugar to the United States. Local groups overthrew the monarch and instituted a republic in 1893. In August of 1898 the United States formally annexed the islands, and two years later they were granted territorial status. Also in 1898 the Spanish American War was fought, leading to acquisition of the other Pacific territories of Guam and the Philippines.

Strategically this was an important event for the United States. By virtue of the war it suddenly found itself a colonial power and the strong performance of the American Navy also afforded it considerable respect. The Hawaiian Islands immediately became an essential coaling and logistical station for any traffic to the new territories in the western Pacific. A garrison of volunteer infantry and engineers was quickly dispatched from the US to Oahu, replaced in 1899 by four regular batteries of the Sixth US Artillery Regiment. Regular units of the US Army have been stationed on Oahu ever since. The completion of the Panama Canal in 1914 added strategic importance to the island base. While the US Navy at times vacillated between having Oahu as its primary Pacific base and merely using it as a "forward" base, it soon became an essential element of all potential Pacific war planning, thus needing a strong and dedicated defense.

An important military consideration for the Hawaiian Islands was the makeup of its population. A large influx of foreign people had added significantly to the original inhabitants. Japanese, Chinese, Koreans, Filipinos, and several European/American nationality groups had settled in the islands from the 18th century, primarily attracted by opportunities for agricultural work. In 1898, after the native Hawaiians, the next largest population groups were Japanese and then Chinese. By 1908 Japanese made up 40 percent of the population – and only slightly less in 1941. The military always had concerns over the loyalty of the local population, especially the Japanese, and the potential for unrest in the event of war. Serious war scares with Japan in 1907 and 1913 added a sense of urgency to building the islands' defenses and protecting the security of military facilities. From its first arrival on Oahu, the Army considered the possible suppression of the local population as one of its missions. While the American military was slow to recruit militia or local guard forces in all the new territories, the ethnic makeup in the Hawaiian Islands made it a particularly noticeable phenomenon there. In the early years the Army would not be able to count on significant local forces augmenting its strength in times of emergency. Even by 1941 one of the major distractions of the American command was the concern over sabotage and espionage – as it turned out, a threat that never materialized.

One of the favorite image poses by troops at larger gun batteries was "the guy in the breech." This 1918 picture features a coastal artilleryman of the 9th Company in the 14in. No. 2 gun, Battery Randolph, Fort DeRussy. (AM)

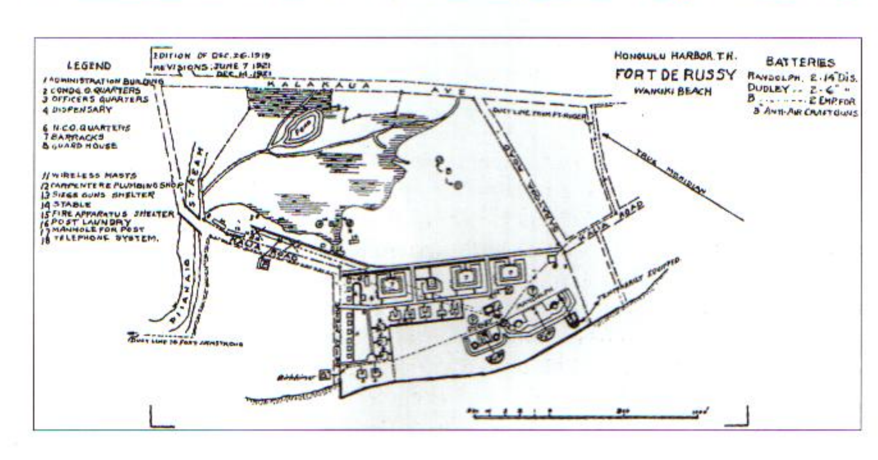


The initial Oahu defense plans

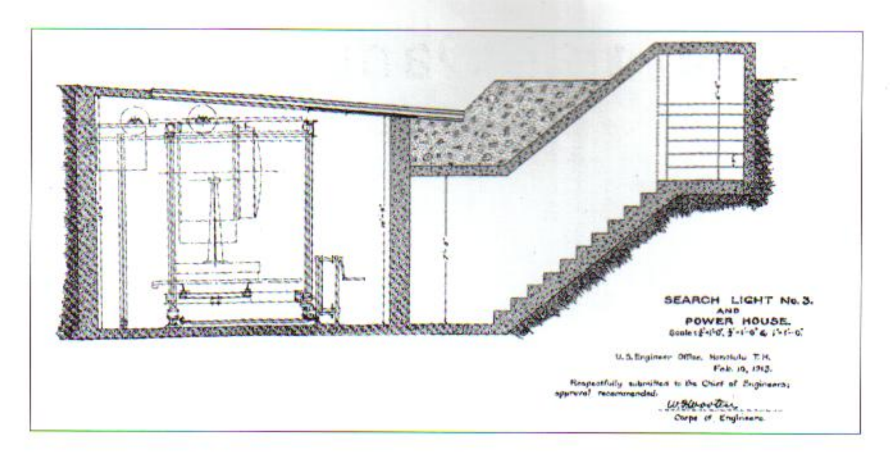
In September 1901 a local board of US Army engineer and artillery officers was created to provide the framework for permanent seacoast defenses for Oahu. They were to specify a project for the fixed artillery defenses, to include land acquisition, costs, and garrison requirements. These early proposals all foresaw the dual defense of both Pearl Harbor (the coaling and future naval base) and Honolulu (the largest commercial port). Fortunately these were only seven miles apart, with the largest seacoast guns being able to provide coverage of both locations. Honolulu benefited from natural openings in the offshore coral reef allowing easy maritime access. The entry to Pearl Harbor was more restricted by the reefs, but its potential as a major anchorage and naval base was recognized, and could be improved with dredging.

This early plan identified locations for defensive batteries. The right flank of the defense project would be at Ahua Point, just east of the Pearl Harbor entrance, mounting 12in. guns and mortars. Diamond Head Crater (just east of Honolulu) would be the left flank, also mounting the same type of weapons. Between the two flanks would be a small post on Waikiki Beach, mounting a battery of 10in. guns. Smaller rapid-fire guns would supplement the defensive coverage against smaller ships. These guns would be located in each of the forts and at Punchbowl Crater, located between the two harbors. A controlled minefield would block the narrow entry into Honolulu, though the deep water offshore would not permit the use of mines to prevent naval bombardment. The board also recommended that a pair of Navy coastal defense monitors be stationed at Oahu. Land defense needed only a few batteries of siege guns to cover the important passes in the two mountain ranges so these coast defense works and the harbors could not be seized from the rear. Total garrison for this defense would be four companies of coast artillery (increased to ten in times of war) and two battalions of infantry. Punchbowl and Diamond Head were already US government reservations; additional land would have to be purchased at Ahua Point and Waikiki. It would still be several years before any appropriations would permit permanent construction to begin, but many of the elements of this first detailed plan would be seen again when work finally started.

By 1900 the American system of coastal defense was well developed. After a period of decline following the American Civil War, coast defense was vigorously developed, starting in 1886 with the advent of the Endicott Board's recommendations. From 1886 onward progressively larger congressional



Fort DeRussy was the first to be armed with the Taft-era defenses in Oahu. It comprised the two 14in. disappearing guns in Battery Randolph (the largest weapons on the island until the arrival of the postwar 16in. guns) and the two 6in. guns of adjacent Battery Dudley. It was a relatively small post, a reflection of the high cost of real estate in the Waikiki Beach area. (NARA)



A cutaway section of Oahu's searchlight No. 3. One of the eight original 60in. searchlights, No. 3 was located in a protected bunker on the southwestern slope of Diamond Head. It was elevated and retracted by use of levers and screws. A 50hp General Electric gasoline engine driving a 25kW direct current generator supplied its power. This emplacement was completed in 1911 and served for many years. (NARA)

appropriations were made for land, concrete emplacements, and specially developed modern breech-loading guns and carriages. Twenty-six major American continental ports were provided with modern batteries of guns, and most with submarine mine defenses. This new generation of fortifications emphasized the provision of forts as reservations of land with dispersed, well-protected gun emplacements, as opposed to the distinct, large masonry forts of the previous eras. Rifled guns were grouped into batteries holding anything from one to seven pieces of ordnance, but most commonly two. The primary weapons were of 8, 10, or 12in. caliber, and usually mounted on "disappearing carriages." These were complex traversing carriages allowing the gun to be fired over a protecting parapet at the enemy, and then retracted by the gun's recoil for reloading and servicing between rounds. At some locations conventional "barbette" carriages were used. Smaller guns of 3, 4.72, 5, and 6in. caliber were provided for minefield and supporting coverage. These could be on either disappearing (or the related "masking parapet" type) or on quick-traversing barbette or pedestal mounts. The Army also extensively used a short-barreled 12in. rifled mortar. These were usually emplaced in paired pits of four or later two guns. While of shorter range, when fired together they could deliver a powerful barrage onto the decks of besieging enemy ships or landing operations.

Controlled minefields were also operated by the Army defenses, where channel or water conditions allowed. Toward the end of this fortification period (c. 1914) the forts were provided with searchlights for night firing, electrical power plants, and new fire control systems based on either horizontal baseline or depression finder optical equipment in specially constructed stations or bunkers. It is important to note that coast artillery was the dominant Army activity for much of this period. Many of the forts became quite large with significant garrisons and permanent barracks and other base structures. The US Army Corps of Engineers spent much of its military activity in the design and construction of these batteries, as did the US Army Ordnance Department in developing the weapons themselves. In 1907 the artillery service was split, and the Coast Artillery Corps became an important branch of the Army. Garrison troops were organized at first into individually numbered Coast Artillery Companies, and then in 1924 into Coast Artillery Regiments. The defensive recommendations for Oahu were not unique technology, but were a logical adaptation of an existing system for a new location.

In January of 1905 a new national board was constituted to review and recommend changes to the original Endicott Board. It was known by several names, including *The Board to Revise the Report of the Endicott Board*, and later *The National Coast Defense Board*, but today it is usually referred to with the name of its chairman, William Taft, as *The Taft Board*. The task of the board was to identify and recommend defense changes stemming from either new technology (such as the

Sgt Henry Cole of the 68th Coast Artillery relaxes in typical barrack quarters. Cole served with Battery Hasbrouck, Fort Kamehameha, from 1913–15. He was an avid amateur photographer and left an excellent series of photographs now at the Army Museum of Hawaii. (AM)



searchlights, power, and fire control systems mentioned above, and the development of a new 14in. gun), or from changes in harbor priorities. In the latter category were the needs of America's new island possessions and the Panamanian isthmus. This board reviewed the needs of Hawaiian coast defense, incorporating and modifying the previous reports into its final congressional message.

The Taft Board's final report was issued on January 15, 1906. It recommended new defenses for six insular ports, including the combined Pearl Harbor and Honolulu location. Also included were the initial plans for both sides of the under-construction Panama Canal, and substantial improvements to the defenses of Chesapeake Bay. The specific Oahu plans called for coast artillery at the following locations:

Queen Emma's Point and Ahui Point (sic):

2 x 12in. guns

16 x 12in. mortars

Puuloa:

2 x 12in. guns

Waikiki Beach:

2 x 12in. guns

Honolulu Harbor entrance:

4 x 6in. guns

Costs were estimated at $3,254,000, of which $2,544,000 was for the purchase of the military reservations and the guns and emplacements to be built on them. The balance was for the mining defense, power plants, searchlights, and fire control stations. Curiously at this stage the Oahu defenses were placed in the second category of priority, clearly behind those for the Philippines. While the report does not explain this prioritization, it was probably due to the still-unimproved state of Pearl Harbor and the absence of a clear decision to develop the harbor into a major base.

The original Taft Board's recommendations were soon modified by the War Department. The newly developed 14in. gun placed at Waikiki Beach was ideal to allow coverage of both Honolulu and the entry into Pearl Harbor. The 16 mortars were now to be split into two batteries: eight mortars for the joint Pearl Harbor/Honolulu defense, and the other eight on the eastern side of Diamond Head to assist in covering the anchorages on the eastern side of Oahu in addition to Honolulu. Two batteries of 3in. guns covering the minefield were also added to the plans. The battery at Puuloa was dropped. These changes reduced the expected total expenditure by $318,660. This final recommendation was close to what was finally built in the following years as the first phase of the seacoast defenses for Oahu.

Building the defenses

The first phase of coastal defenses

The first US Congressional appropriations for Hawaiian seacoast batteries were made in the Fortification Act of June 1906. Larger appropriations made from 1907 through 1912 resulted in the construction of eight permanent batteries on four distinct military reservations. The reservations and their constituent batteries are listed below.

Fort Kamehameha (named after the Hawaiian king) was established on the eastern bank of the entry into Pearl Harbor, and for a short time was named Fort Upton. This low-lying piece of sand and coral ground (generally known as the Queen Emma tract) was subject to occasional flooding and was covered with scrub of lantana and algaroba trees. It was easy to build on, and provided clear, if somewhat low, fields of fire for the batteries. In May of 1907 a plan was submitted for a large two-gun 12in. disappearing gun battery. The work was named **Battery Selfridge** and mounted two 12in. m(odel)1895M1 guns on m1901 disappearing carriages, completing for transfer to coast artillery troops in August of 1913 for a total emplacement cost of $440,000 (the figures throughout do not include the cost of the weapons themselves). **Battery Jackson** was built just to the west of Selfridge. This emplacement carried two 6in. m1908 guns on m1905MII disappearing carriages, and was completed in June of 1914 for $86,000. A little further west on the same line was **Battery Hawkins**, comprising two 3in. m1903 guns and pedestals and completed in March of 1914 for $22,200. The last completed battery for the initial Fort Kamehameha defenses was **Battery Hasbrouck**, the mortar battery of eight 12in. m1908 mortars in two four-gun pits located on a corner of the fort reservation. It was transferred in November of 1914 for a cost of $274,161.

A small reservation at Kaakaukukui Reef near the Honolulu port quarantine station was set aside as **Fort Armstrong**, to serve as the chief mining station for the defenses. It received **Battery Tiernon**, built in 1909 and transferred in June of 1911 for a cost of $20,000. It carried two 3in. m1903 guns on pedestal mounts to cover the minefield. A new concrete mining wharf, a mine storehouse, loading room, cable tank, and mine casemate (where the mines were electrically controlled) were also constructed between 1911 and 1913.



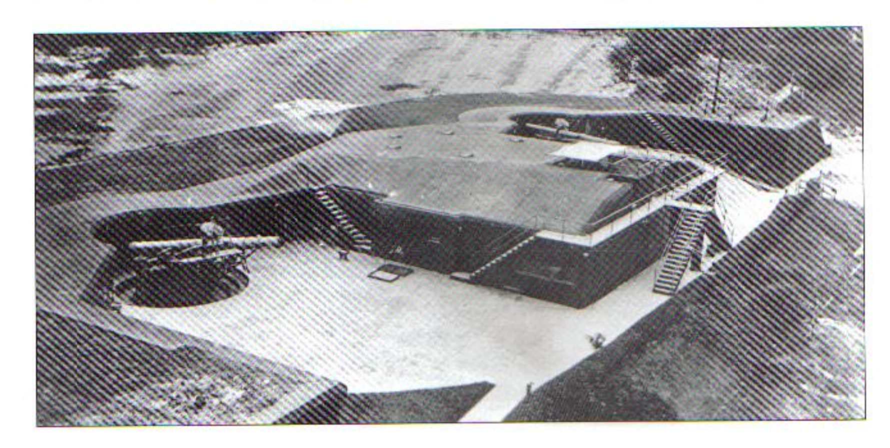
The US Army minelayer *General Royal T. Frank*. A vessel of 622 gross tons, she was constructed in 1909 in New Jersey, but spent much of her service life in Hawaiian waters. She ended her service days as an inter-island transport for the military, and was sunk off Maui by a Japanese submarine on January 29, 1942. (AM)

On Waikiki Beach another small reservation was purchased and named **Fort DeRussy**. Even at this time land was very expensive on this famous beach: the high cost was even discussed in congressional hearings in Washington, D.C. At this post was built the largest, best-armed battery of this period, **Battery Randolph**, carrying two 14in. m1907 guns on disappearing carriages. The local chief engineer officer, primarily using department-supplied type plans adapted to local conditions, designed the emplacements. For much of the period the works on Oahu were supervised by Major Eben Eveleth Winslow, US Corps of Engineers. Winslow was stationed in Honolulu between 1908 and 1911, and eventually became Chief of Engineers for the Corps, and a recognized author and authority on the subject of permanent fortifications. His design for this 14in. battery was submitted in November of 1908. It was completed by October of 1913 at a construction cost of $428,893.

Batteries Randolph and Selfridge were typical designs for the period, consisting of large two-story reinforced concrete structures, mounting the guns on carriages on the upper level (and protected primarily in front by thick concrete and sand parapets), and having lower level ammunition magazines with shell and powder delivered by integral hoisting machines. Auxiliary rooms for tools, latrines, supplies, plotting, and command filled out the structure. Except in times of battle the manning garrison did not stay in the batteries, but rather was housed in conventional barracks or quarters nearby on the post reservation. Very close on the right flank of Randolph was another 6in. battery, **Battery Dudley**, comprising two 6in. m1908M1 guns on m1905MI disappearing carriages. It was completed by August 1913 for $75,000. These smaller 3in. and 6in. batteries mimicked the layout of the larger ones, consisting of separated gun platforms behind parapets, intervening concrete and earth traverses, and heavily protected magazines.

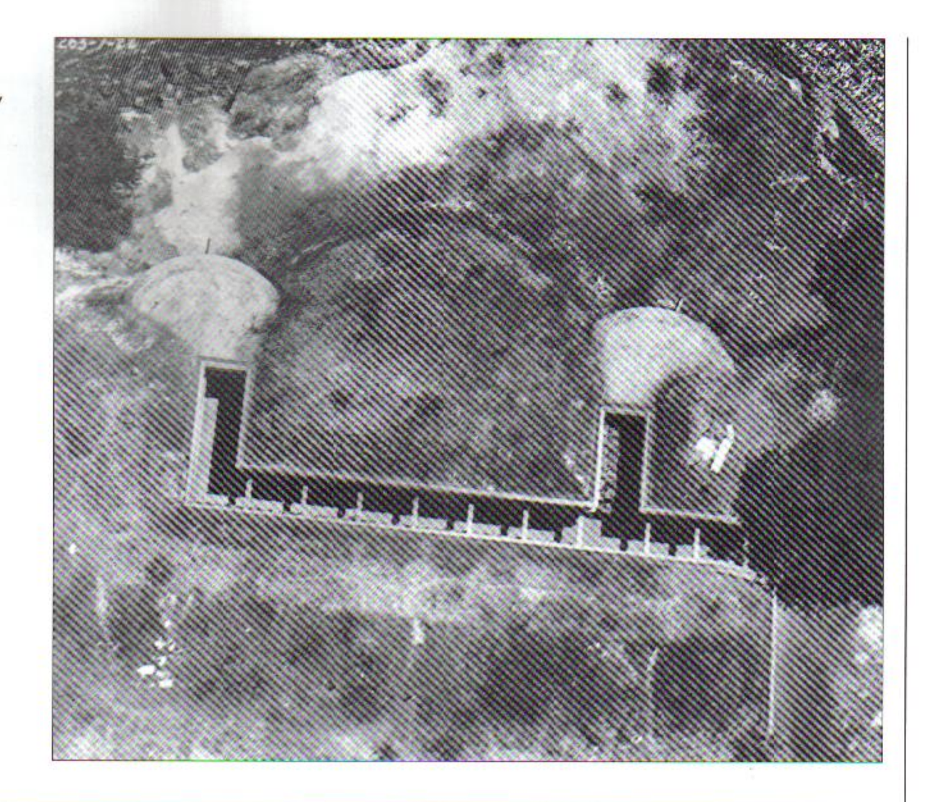
The final reservation, **Fort Ruger**, was selected as the site for the mortar battery intended to anchor the eastern end of the defenses. This reservation included the Diamond Head volcanic crater so prominent in period photos and postcards. A site for the mortars was selected outside the crater on the eastern side to provide fire covering both Honolulu and potential enemy flanking landings near Waialae. The high-angle fire of the mortars allowed it to be set close to the crater wall, precluding it receiving return fire from conventional ship armament. In fact the position was so well protected that the plan omitted the usual frontal parapet protection to save cost. Named **Battery Harlow**, it was armed in 1909 and transferred in March of 1910 for $205,000. Unlike its sister mortar Battery Hasbrouck, it was armed with older m1890M1 mortars, actually using surplus mortars relocated from the US mainland.

Beside the artillery emplacements at each fort, a whole range of supporting structures was needed to complete these reservations. An additional mining casemate was provided for Fort Kamehameha. The mining plan called for three groups of 19 mines each for Pearl and Honolulu Harbor. In 1913 the Army



The dual 6in. disappearing batteries, such as those of Battery Jackson at Fort Kamehameha shown here, were smaller versions of the larger batteries. This photograph was taken prior to World War I: the guns are in the lowered, loading position. (AM)

Battery Adair at the eastern tip of Ford Island, inside Pearl Harbor, in plan view. This casemated battery was armed with two aging, British-made 6in. guns: they fired inland as an element of the 1915 Land Defense Project. This photograph was taken August 23, 1922 by a Navy seaplane. (NARA)



The official US Army Report of Completed Works for batteries Barri and Chandler corrected to June 14, 1919. As part of the Land Defense Project, the emplacements were given concrete overhead protection, and were armed with 4.72in. and 3in. guns. (NARA)

REPORT OF COMPLETED WORKS, SEACOAST FORTIFICATIONS
(Battery Plan)

Corrected to June 14. 1919

FORM 7

LAND DEFENSES OF PEARL HARBOR
FORT KAMEHAMEHA
BATTERIES BARRI AND CHANDLER
TWO GUNS. 4.72 CALIBER BARBETTE CARRIAGES
TWO GUNS. 3" CALIBER BARBETTE CARRIAGES
(Graphic Scale)

REAR ELEVATION

REAR ELEVATIONS

GENERAL PLAN

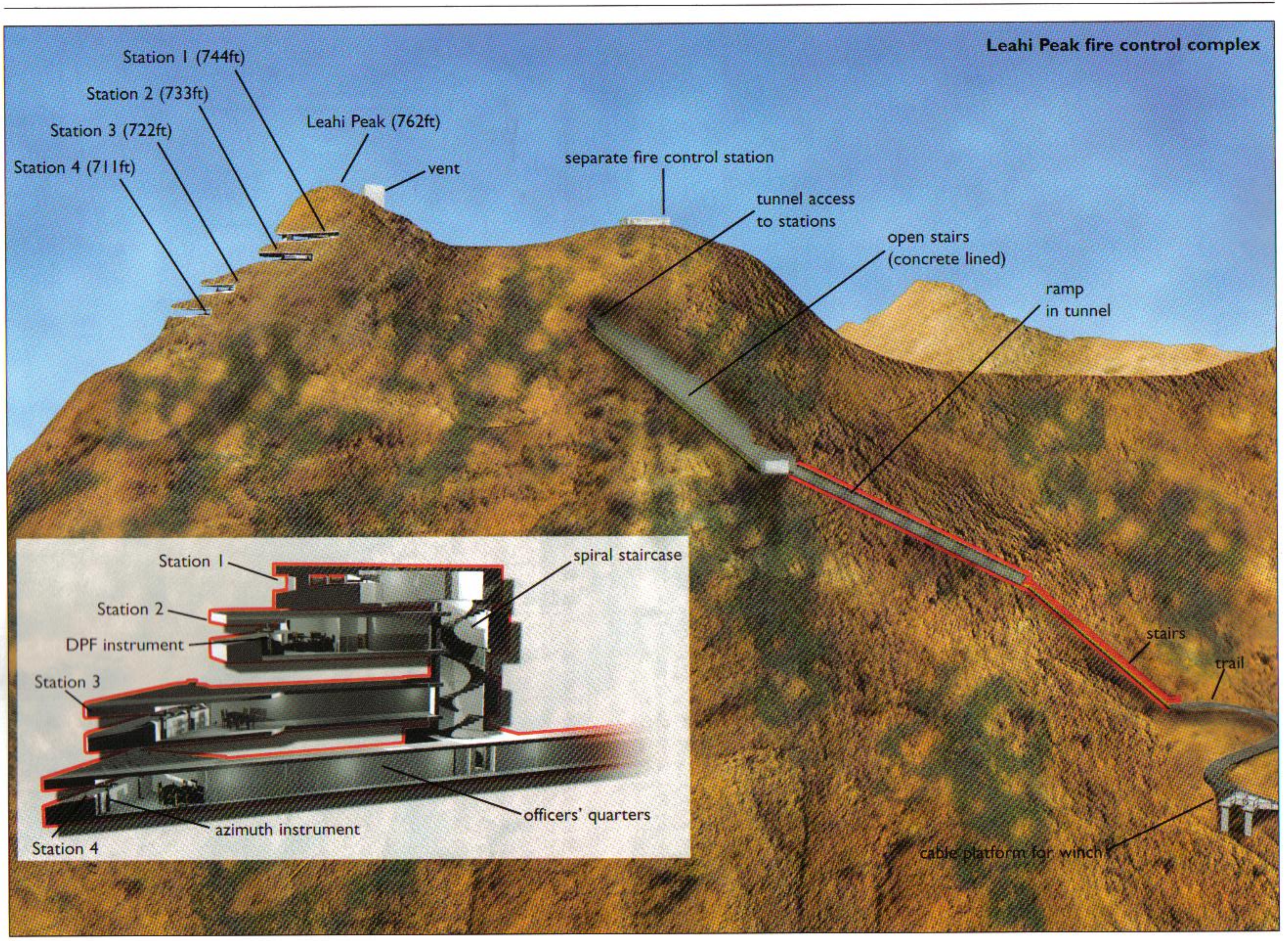
CROSS SECTION A-A

CROSS SECTION B-B

REAR ELEVATION

1 Officers Latrine
2 Mens Latrine
3 Magazine
4 Magazine
5 Bomb Proof
6 Bomb Proof
7 Bomb Proof
8 Magazine
9 Magazine
10 Fan Room
11 Engine Room
12 Store Room

Note: All elevations are referred to M.L.L.W.
Prior to an engagement the roofs of the gun chamber should be covered with sand bags to a thickness of five feet or more, and the angles between the side walls of the gun chamber and earth parapets filled with sand


Leahi Peak fire control complex
Station 1 (744ft)
Station 2 (733ft)
Station 3 (722ft)
Station 4 (711ft)
Leahi Peak (762ft)
vent
separate fire control station
tunnel access to stations
open stairs (concrete lined)
ramp in tunnel
stairs
trail
cable platform for winch
Station 1
Station 2
DPF instrument
Station 3
Station 4
spiral staircase
officers' quarters
azimuth instrument

assigned the mine planter *Major General Samuel Ringgold* (not a Navy, but an Army vessel) permanently to the Oahu defenses. Sites were selected and small concrete-protected emplacements were built for 60in. searchlights. Numerous fire control stations mounting observation instruments were emplaced. As these instruments worked best with elevation, some at Kamehameha and DeRussy had to be built on tall metal towers, while others at elevations like the Punchbowl and Diamond Head could be constructed as simple concrete boxes with observation slits on or near the crater crests. The posts received power plants, barracks, officers' quarters, supply, medical, engineering buildings, and other essential facilities for the garrison in short order. By the start of World War I in Europe, the first generation of seacoast defenses of Oahu was complete and ready for duty.

The initial land defense project

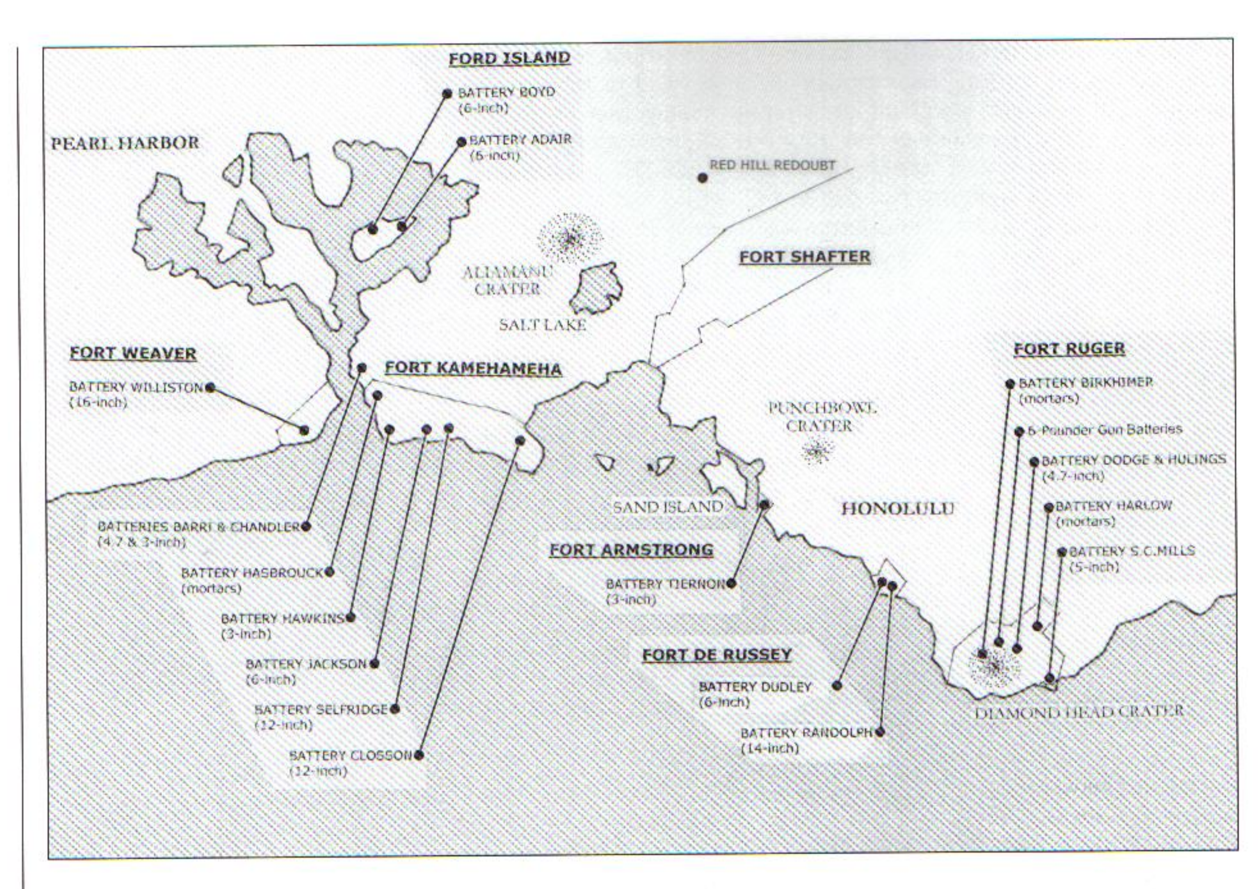
Not long after the fixed coastal defenses were begun, the Army turned its attention to defending against enemy landings and the possibility of attack from "the rear." The Oahu coast defense forts were entirely open and accessible landwards: there was usually nothing more than a simple fence separating the reservations from the adjacent landowners. The batteries themselves had absolutely no defensive cover or positions to allow infantry defense: even the guns themselves were limited to frontal traverse and, except for the mortars, could not readily fire to landward. Starting in 1910 a series of Army local boards and officer reports were made on the subject of land defenses, the project itself going through a variety of specific recommendations for both fixed and mobile defense.

The basic idea of these plans was to set up a defensive area or "box" to include the four coastal forts, the Pearl Harbor Naval Base, and the city of Honolulu. The decision to fortify a defensive perimeter that included most but not all of the key military sites was driven by limitations in manpower and funding. While augmentation of the mobile forces was requested, in reality only about 7,500 Army troops in total were available to the defenders at any time prior to World War I. A landward defensive line was proposed that capitalized on the strong natural terrain features of Oahu, with certain fixed elements at key points and new fixed artillery batteries and searchlights installed to cover the line and its approaches. The idea was that the local garrison could hold out, while denying the enemy use of the harbors, until relieved by American forces from the mainland. Scenarios varied over time, at one point envisioning resistance against as many as 100,000 enemy troops for 30 days.

On the eastern flank of the defense perimeter, Diamond Head Crater was developed into a closed redoubt. Access to the crater itself was only through a tunnel, and from the 750ft crater rim the defenders could dominate all local beaches and approaches. Closing the land gap to the next northern mountain ridge with either fixed or field fortifications would be the most urgent addition to the defense. The first new artillery support needed was a mortar battery actually inside the crater. Not only would it be safer from land attack than

Leahi Peak fire control complex on Diamond Head

Leahi, the most southern peak on the rim of Diamond Head Crater east of Honolulu, was part of the original Fort Ruger Army reservation. It was selected to be the site of a unique multilevel fire control position. The construction work was carried out in 1910, and the complex transferred to coastal artillery troops on January 20, 1911. Four separate station levels were built into the cliff face, each serving a different battery or command: Station 1 served the First Battle Command; Station 2 served the First Fire Command and Battery Harlow; Station 3 served the Second Fire Command and Battery Dudley; and Station 4 served Battery Randolph. The stations were equipped with observation azimuths, plotting boards, and Depression Position Finder (DPF) instruments. The stations were reached using an approach trail, steep staircases, and an unlined tunnel ramp. Cable winches were used to haul supplies up the steep inclines. A small officers' dormitory was located at the foot of the stairs, whereas quarters for enlisted men were in a ravine off the trail further down the slope. The stations served through World War II, and are still accessible today.



The Oahu seacoast and land defense battery locations, together with the positions of the major defensive military reservations and their battery structures built between 1907 and 1925.

Battery Harlow (outside the crater), but it also could be used in a secondary role against naval targets. Along the crater ridge facing east were a series of new fixed batteries for 4.72in. and 6pdr guns, laid out to fire on the eastern, landward approaches. On the shore at Kupikipikio Point (later known as Black Point) would be another rapid-fire light battery to protect the local searchlights and provide flanking fire on any infantry approach.

Battery Birkhimer was the new mortar battery, and was actually one of the last elements of the plan completed. Located on the northeast side of the crater interior, it comprised four m1890M1 mortars on m1896 carriages. Work was carried out from June 1915 to April 1916 for a cost of $190,000. It was soon found that there were flaws in the battery design, and it was rebuilt with the same four mortars deployed outside the pits in linear arrangement in 1921. Up near the crater crest new positions for two batteries were tunneled through the rim completely, each mounting two 4.72in. guns. **Battery Dodge** and **Battery Hulings** were built simultaneously from September 1914 to October 1915, and transferred that October at a cost of over $15,000 each. Finally, small positions were prepared for twelve 6pdr (2.24in.) coast artillery guns on wheeled m1898 carriages on the northeast crater lip. These small emplacements were never named, and only show on period maps with lettered battery designations. At the separated Kupikipikio Point reservation (still administratively part of Fort Ruger) **Battery S.C. Mills** was built. It carried two 5in. m1900 guns on m1903 barbette carriages with steel shields. Like all the batteries except the mortar one, S.C. Mills was casemated and had an earthen parados to protect its rear from naval shelling. Work was carried out between 1914 and 1916, and the transfer completed in December 1916 for $30,560.

To the western flank behind Honolulu peaks and slopes protected the land approaches, though the side towards Pearl Harbor opened into a small plain. However a deep ravine ran through from Red Hill to the Salt Lake Crater,

providing a natural trench and defense line some 100–500ft in depth. Here the project called for a strong infantry redoubt at Red Hill to provide a flanking position on the ravine and protection for two companies of infantry. This redoubt was built and completed by early 1920, below the crest on the south slope of Red Hill. It was a concrete structure 274ft by 14ft. It had five shelter rooms each 40ft long, and a large magazine.

In the middle of Pearl Harbor was Ford Island, a good natural position to place flanking land defense guns to cover the western approach to the line. The Army acquired the land in 1915, and in 1916–17 built two 6in. batteries, **Adair** and **Boyd**, which were transferred in 1917 for $59,000 and $44,600 respectively. They were armed with 6in. Armstrong guns, firing to the north and west. The batteries were given full overhead protection, and built with a cut-and-cover construction technique. The final unit of this scheme was a new protected battery at Bishop's Point, a natural feature in Pearl Harbor on the west side of the Fort Kamehameha reservation. Guns firing to the west could not only provide artillery fire on the western approaches to the harbor, but could also give additional light coverage to the harbor channel itself in an anti-torpedo boat capacity. **Battery Barri** (two 4.72in. guns) and **Battery Chandler** (two 3in. m1903 pedestal guns) were emplaced in a box-like redoubt, and also given strong overhead casemated protection. This work was carried out from September 1914 to September 1915, with transfer being made for $29,043 and $26,923 respectively.

Considerable discussion took place in these years as to the suitable garrison for Oahu's mobile defense. Two Army reservations for mobile troops were constructed at the same time the initial coast artillery forts were established. **Fort Shafter** was built on a 1,344-acre reservation in the foothills of the Koolau Mountains between Honolulu and Pearl Harbor as a permanent base for mobile troops. **Schofield Barracks**, a much larger facility (eventually encompassing 14,000 acres) including adequate room for training and maneuvers, was built on the Leilehua Plateau astride the approaches from the landing beaches on the island's northern shore. The 1913 Army garrison was about 7,500 men, comprising three regiments of infantry, one each of cavalry and field artillery, eight companies of coast artillery, and one each of engineers and signal corps. As the Red Hill–Diamond Head defensive line included Fort Shafter but not Schofield Barracks, the recommendation was to reposition the mobile forces. Fort Shafter was to accommodate most of the brigaded infantry and field artillery, and permanent structures such as the major Army hospital. Schofield Barracks, which would have to be abandoned under a siege plan, would have the cavalry and the other mounted units. The Honolulu quartermaster and ordnance depots would be stocked with six months of rations and clothing for the Army, and also a partial reserve of food for the civilian population of Honolulu. Over time this allocation of units was not adhered to, and both Shafter and Schofield grew into significant Army posts with many permanent barracks and other base facilities.

The 1915–16 board additions

Two important board recommendations resulted in significant additions to the defenses of Oahu. In 1915 the War Department commissioned a new Board of Review under Brig.Gen. Hugh Scott to address updating American defenses. Of particular concern at this stage were the war in Europe, and the trend in naval armament towards heavier and more long-range battleship guns. These new weapons could essentially outrange the existing 12in. and 14in. disappearing guns emplaced in many American harbors. The board report recommended that pending development of new larger weapons, new batteries of 12in. guns on specially designed long-range barbette carriages be distributed among the important harbors. Additionally some locations would receive 16in. howitzers or guns. Oahu was selected to receive six of these new 12in. guns, at an estimated cost of over $1.1 million. Two guns each were to go to Fort Kamehameha, Fort Ruger, and at the Schofield Barracks Reservation. However for a variety of reasons

only a single battery for two of these guns was eventually erected on the Fort Kamehameha reservation.

The location for this emplacement was on newly reclaimed land immediately to the east of the Fort Kamehameha reservation. The emplacement consisted of a large concrete and earthen covered magazine, with the two gun blocks sitting on either end, with a distance of 420ft between them. It mounted two of the older 12in. m1895M1 guns on the new high-angle m1917 barbette carriage. These 12in. guns had a range of over 30,000 yards compared to 19,000 yards of the older disappearing gun arrangement. **Battery Closson** was begun in September 1917. It was not completed until May 1920, the emplacement costing just over $300,000. Battery Closson remained a key element of the defenses until after World War II. While the open-mounted guns were totally unprotected from enemy bombardment, the mounting allowed a 360-degree field of fire, greatly adding to the potential coverage of all but the most northern Oahu beaches.

Another important step was taken a year after the 1915 Board of Review. In September of 1916 a special local Army Hawaiian Board was constituted to review and recommend anti-aircraft defenses for the islands. Up to this time little thought had been given to defense against the emerging threat of air attack. The older Taft-era batteries were vulnerable from the air, and even the new design of the long-range batteries left the guns themselves exposed, with camouflage the only protection. The board's eventual proposals were probably the result of mandated War Department procedure rather than perceptive realization in Honolulu, as the Hawaiian Islands were beyond the range of any existing 1916 aircraft (the first American one-way non-stop journey to the islands would not occur until the trans-Pacific flight of 1925), and the world's first true aircraft carrier was not commissioned until 1918. Nonetheless the board pursued its charge, recommending in 1917 14 two-gun batteries for 3in. anti-aircraft (AA) guns spread about eight locations (Fort Ruger, DeRussy, Kamehameha, Shafter, Punchbowl, Sand Island, Ford Island, and Schofield Barracks). At that time the Army assumed that the Navy would mount their own fixed AA guns at their Pearl Harbor station. Most of these emplacements were immediately built in the summer of 1917. They were simple concrete foundation blocks and adjacent concrete-covered magazines serving each pair of guns. The weapons themselves (the newly developed 3in. m1917 AA gun) were not received until after the war and mounted on these blocks in 1920.

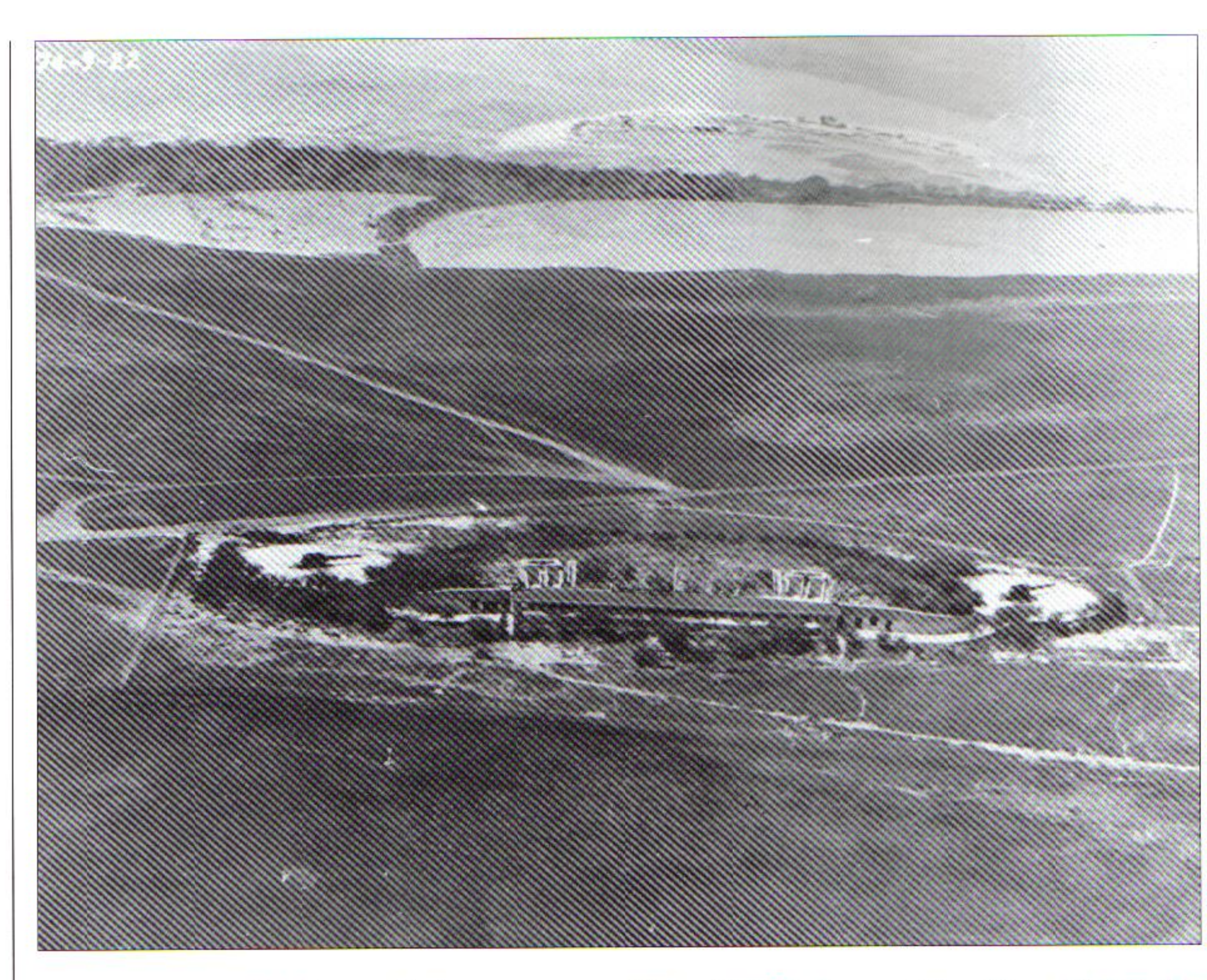
The final addition in this period saw the mounting of the most powerful weapon in the American military arsenal. Oahu was selected to receive a pair of the 16in. m1919MII Army guns on long-range barbette carriages. This weapon fired a 2,340 lb projectile to over 25 miles, and was the most powerful service weapon ever produced by the United States. The site selected was at Iroquois Point, a new reservation on the western side of the Pearl Harbor entrance. The battery plan was even simpler than the 12in. long-range battery. The gun carriages were mounted on concrete blocks, which in turn were connected to dispersed lightly constructed magazines by a dedicated railway. The only protected concrete structure was the plotting room. **Battery Williston** was started in October 1921 and completed in September 1924. The emplacement cost just $121,549; the

The land defense batteries of Fort Ruger, 1916

After construction of the initial seacoast defenses between 1907 and 1914, efforts turned to developing a defense against potential enemy landing forces. New batteries, field works, and weapons were designated to protect the major military and civilian centers from the north. Fort Ruger was the eastern anchor of this plan, and it received new batteries on the north and eastern rim of the crater. Pictured here in the fore of the illustration are the two 4.72in. guns of Battery Hulings. The casemates were built by tunneling through the crater lip. In the upper right is one of the 12 emplacements built for 6-pdr (2.24in. or 57mm) seacoast guns that would have been moved here from storage in the event of an emergency. This defensive plan lasted for just a few years, between 1916 and 1921: after this date, most of the guns were declared obsolete and scrapped.



Fort Ruger, 1916



An aerial view taken in 1922 of the recently completed Battery Closson, Fort Kamehameha. The battery featured special long-range barbette carriages to allow its 12in. guns maximum range. While its magazine complex (between the guns) is protected by a concrete and earth cover, the guns themselves are open mounted. (NARA)

plotting room was an additional $65,271. It mounted two 16in. m1919MII rifles on m1919 barbette carriages. The new reservation itself was named **Fort Weaver**: initially it was without garrison facilities, with soldiers being transferred by boat from Fort Kamehameha as required, but eventually a small cantonment was built on the reservation.

Military development to 1925

The development of the naval base progressed regularly through the early years. Pending the dredging and opening of the entry into Pearl Harbor, the US Navy had initially used Honolulu for its Hawaiian Naval Station. The US Congress first approved $100,000 for work on cutting through the reef into Pearl Harbor in 1900, and followed a year later with funds to begin acquiring the appropriate land around the harbor (a process of condemnation that took many years and much court time). Despite being the only location in the island chain with the potential to become a major base, real impetus for development only started in 1907. In that year a joint Army–Navy board called for the establishment of a major Oahu naval facility. The visit of the American Great White Fleet in 1908 (which had to dock in the Honolulu commercial harbor just one ship division at a time) coincided with an appeal by President Roosevelt to Congress for Hawaiian military funding. In May 1908 over $3 million was allotted to improve the channel into Pearl Harbor, and to build a battleship-sized dry dock and supporting shops and coaling depots. Strategically Japan was emerging as a major Pacific naval power, and in the Russo-Japanese War had demonstrated the ability to strike decisively if need be.

In fact one of the major driving factors in defending Oahu was to prevent its potential use to the Japanese as an advance base to attack the US mainland.

Development of the naval base after 1909 was steady if not spectacular. Dredging of the sand and coral heads at the harbor mouth continued progressively. The first warships entered Pearl Harbor in 1911. The administration of the Honolulu Naval Station was moved to the **Pearl Harbor Navy Station** in 1913, and a large floating crane was delivered in 1914. The 14th Naval District was organized here in 1916, and the 1,000ft dry dock completed in 1919. While Pearl Harbor was a good natural harbor, it did suffer problems, mostly logistical due to the isolation of the islands. The military services worried about the lack of both self-sufficiency in food and local industry to support the base: the shortages of skilled labor and adequate local supplies were concerning. The Navy always viewed the base as a good repair facility, but avoided placing many shipbuilding projects at the yard due to high costs. Additionally, Oahu was not on the major east-west trans-Pacific maritime route. Most commercial traffic sailed north and east of Hawaii, unless destined for the islands themselves.

Initially there were not many ships or squadrons permanently assigned to the islands. The first real naval units were F-class submarines that moved to a new submarine base on Kuahua Island within Pearl Harbor in 1914. Eventually this presence grew into the 14th Submarine Division and expanded significantly by the outbreak of World War II. In May 1919, the US Fleet was administratively split into Atlantic and Pacific fleets. While the Pacific Fleet was home ported on the West Coast, it was recommended that Pearl Harbor be developed into a first-class base capable of berthing the entire fleet if strategically or tactically required. Nonetheless, major surface units were not stationed permanently in Oahu until 1939.

With the completion of Battery Williston, the initial phase of the Army's project to defend Honolulu and Pearl Harbor from attack was finished. In terms of seacoast defense, the preparations were adequate if not overwhelming. Four modern long-range guns were in place – a pair each of 12in. and 16in. rifles. Four older but still useful disappearing guns could also be counted – the two 12in. and two 14in. Taft-era rifles. The various 6in. and 3in. guns of the light defense and mining project were complete. Adequate coverage with searchlights and fire control stations completed the seaward defense. Construction of fixed elements of the Land Defense Project was also complete, though the lack of sufficient mobile troops left a question mark on that project's effectiveness. Anti-aircraft defense, considered less of a priority at that time, had also been addressed with the early-1920s 3in. AA batteries. The major Army forts, both coast artillery and the mobile Army posts, were basically complete in terms of garrison structures.

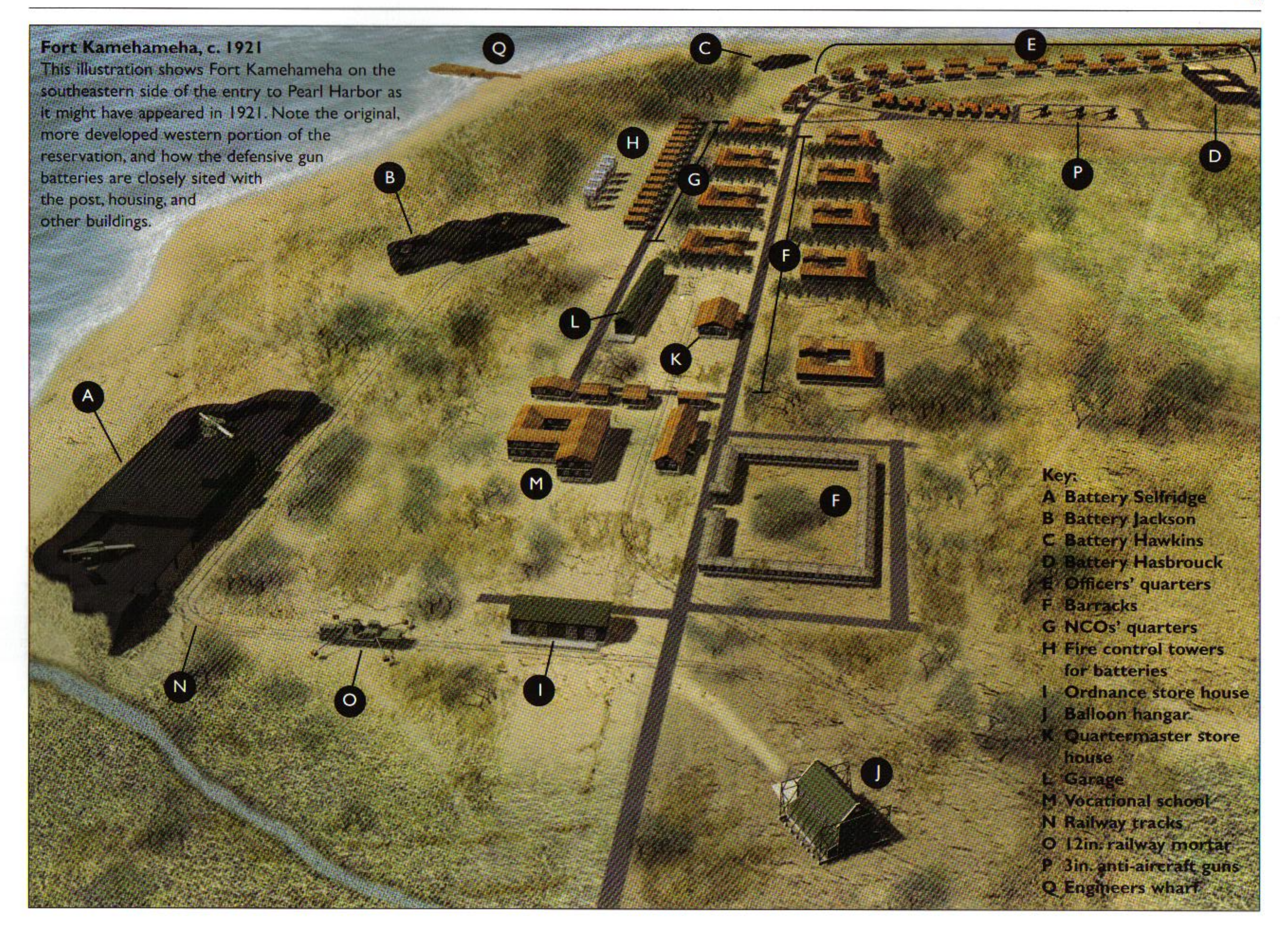
Garrison life on Oahu

The reservations acted both as home to the various fixed batteries and as cantonment areas for the troops manning those defenses. Each post had permanent housing for married officers and NCOs, and large barrack structures for enlisted men. Besides the gun batteries there were also AA emplacements, fire control stations or towers, fixed searchlight positions, power plants (the forts having the capability to generate their own power), plus switchboard, radio, and communication facilities. Typically, the administrative and headquarters offices, ordnance and engineer workshops and warehouses, garages, and other support structures were also on post. There were also recreational facilities for the fort's personnel – clubs, a movie theatre, athletics facilities, a library, a post exchange, and a chapel. While the quality of the construction varied by post and time period, these reservations were always thought of as permanent stations with a high degree of self-sufficiency.

The soldiers assigned to the defenses experienced a wide variance in quality of life over the years from 1907 to 1950. The early years were certainly the roughest. In general, military service in the US armed forces was not well compensated, or widely respected in some quarters. As the permanent posts were being established, physical living conditions were sometimes poor, and relationships with the local, mostly oriental, civilian community was at times strained. Officers could afford alternate standards of living and social involvement with the mostly American business community.

By the 1920s the living and working conditions had greatly improved over the early days on Oahu. In particular, the Coast Artillery was more of an elite corps at this time. It had considerable prestige, was relatively well funded and equipped, had a strong technical and professional dedicated career officer contingent, and prided itself on teamwork activity that encouraged close camaraderie. Additionally, service in exotic tropical environments like Hawaii, the Philippines, and the Panama Canal Zone had its advantages, particularly at a time when many of the tropical diseases had been conquered. Training was emphasized religiously, but in all the workload was reasonable. Pay was not extravagant, but with decent food, recreation, and athletics events now provided on post, there was enough for even privates to enjoy the Honolulu nightlife on occasion. It is important to note that in the period prior to World War II these were mostly professional soldiers. Often enlisting for long periods, they tended to stay in this branch of service and become skilled in what they were taught and highly familiar with the equipment they practiced on.

The actual Army units assigned to Oahu varied greatly in designation. The fixed defenses (seacoast guns, mines, and AA weapons) were manned by units of the Coast Artillery Corps. At first these were separate companies, frequently one assigned per individual battery. Later these units were reorganized into regiments and sometimes separate battalions or brigades. The first large contingent of permanent coast artillery troops reached the island in January 1913, and while there was some unit rotation over time, these units remained in Oahu and were fairly static in size until the build-up to World War II. During World War I there was a considerable exodus of experienced men and officers to serve in Europe; often the replacements were trainees and local guardsmen. The size of the mobile forces tended to vary much more over time. The total garrison available in the Hawaiian Islands dropped from 12,000 men in 1917 to just 4,000 (mostly manning the coast artillery defenses) at the end of World War I.



Fort Kamehameha, c. 1921

This illustration shows Fort Kamehameha on the southeastern side of the entry to Pearl Harbor as it might have appeared in 1921. Note the original, more developed western portion of the reservation, and how the defensive gun batteries are closely sited with the post, housing, and other buildings.

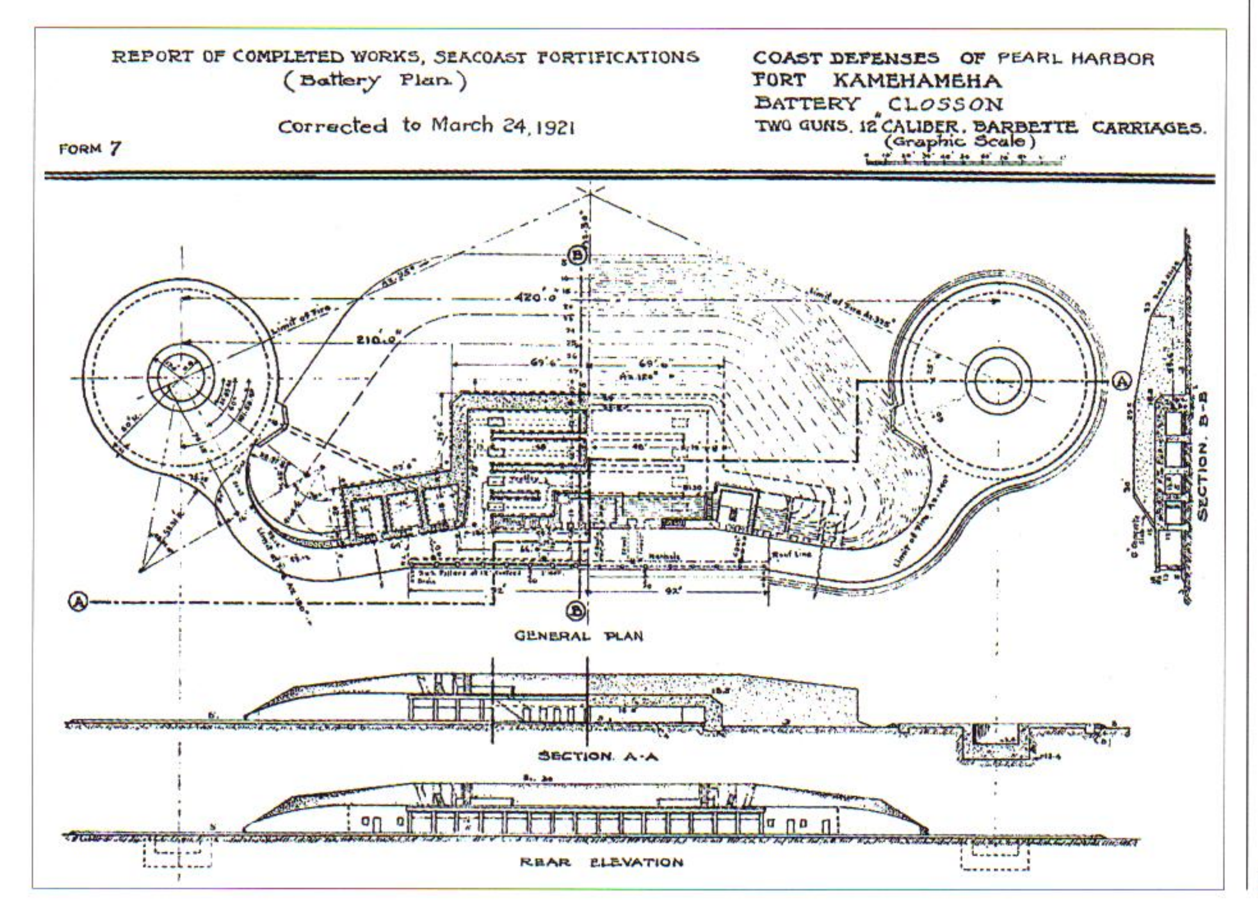
The war plans throughout this period show the mission of the Army on Oahu clearly as the defense of the naval station at Pearl Harbor. While the Army had secondary roles, there was never serious doubt about this major mission. Throughout most of its existence, the local Army command was organized into a separate Department, meant to combine all the various line and service functions in what would otherwise be a remote post. The Hawaiian Department's commander was in effect the supreme Army officer for this geographical area. The command was in turn generally split between the fixed defenses (the Harbor Defense Command, though the names for these organizations changed over time), and the mobile defenses. As the air component of the Army grew in capability and autonomy, it too became a major command under the Department. It is important to note that unlike some other nations, the defense of the naval station was not part of the Navy's mission. Clearly the ships of the fleet were capable of self-defense, and the Navy was engaged in anti-submarine patrols (and because of its available equipment, shortly before the war it assumed long-range aerial patrolling), but it manned no gun, mine, or interceptor weapons to defend the base itself – that was all the responsibility of the Army command. The strong independence of the two US services and their differing missions would lead to inter-service rivalry and problems in communications and joint planning, particularly prior to the start of World War II, and would be a factor in the military failure on December 7.

The Army's major ground forces were concentrated at two posts. Fort Shafter, located on high ground between Pearl Harbor and Honolulu, was created as a permanent post in 1903 and by 1913 it had become the headquarters for the Hawaiian Department. The majority of the ground forces were quartered at Schofield Barracks, a large reservation strategically placed athwart the northern approaches to the southern bases. After 1909 this facility grew in importance, and by the mid-1920s it was the largest Army base operated by the United States. It housed the mobile troops of the Hawaiian Division. This unit had been organized in 1921 with four infantry regiments and organic artillery and engineers as one of the largest and best-equipped American Army units of the time. While America's postwar Army was severely restricted in size by congressional legislation, the Hawaiian contingent was restored to about 15,000 men by the early 1920s and remained the Army's best-equipped overseas garrison. From there it grew gradually until the rapid preparations for war began late in the 1930s.

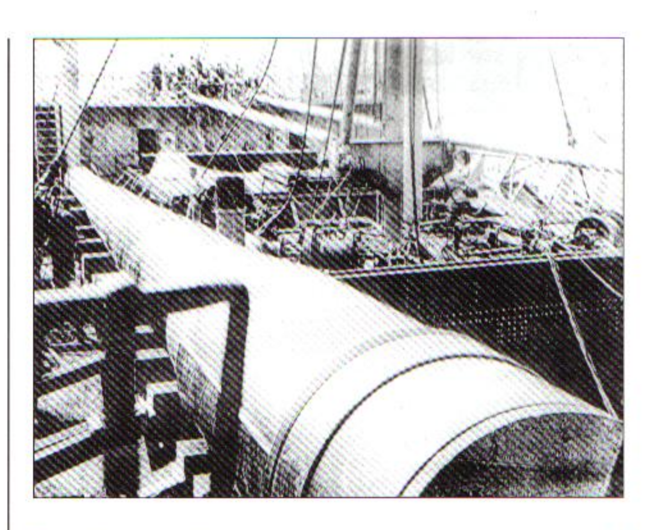
World War I saw the beginnings of an Oahu air establishment. The 6th Aero Squadron arrived on the island in 1917, the first assigned unit. After a short stay at Fort Kamehameha it was relocated to the newly developed **Luke Field** on Ford Island in 1918. The US Navy also assigned aircraft to Oahu, its first seaplanes arriving in 1919 and being quartered within Pearl Harbor. These also moved to Ford Island in 1923, which was then shared by both services. A hard-topped runway and hangars were developed in 1925, when the land defense batteries on Ford Island were disarmed. Soon it became obvious that additional air facilities were needed, and in 1928 work started on acquiring land owned by the Honolulu Plantation Company next to Fort Kamehameha. This area was developed into a bomber field and in 1934 was named **Hickam Field**.

Defense modification between the wars

After World War I, as much due to reasons of cost consciousness as to the lessons learned from it, the Army went through a considerable period of rationalization. Posts were closed, units disbanded, and older weapon systems scrapped. These had an impact even on important strategic locations like Oahu. Even though recently emplaced between 1915 and 1917, most of the land defense batteries were disarmed in the early 1920s. Most of the guns themselves (the older Armstrong 4.72in., 6in., the 6pdr, and 5in.) were declared obsolete and removed from US Army service in 1921. The Oahu defense scheme had changed too, and the concept of the Red Hill–Diamond Head defensive redoubt was abandoned. Batteries Adair and Boyd on Ford Island were deleted by 1925, though the old emplacements were used for a variety of storage purposes. The crater rim batteries at Fort Ruger (Dodge, Hulings, and the 6pdr batteries) were abandoned in the early 1920s. Battery S.C. Mills at Kupikipikio Point was deactivated between 1921 and 1925. On Bishop Point, Battery Barri also was disarmed in the 1920s, but its sister emplacement, Battery Chandler, survived until the mid-1930s. Of the original Land Defense emplacements, it appears that only the mortars of Battery Birkhimer at Fort Ruger survived to the start of World War II, due both to their utility for seacoast defense and the continuing active status of that particular type of weapon. It was also at this time that the various separate coast artillery



The original design plan for Battery Closson, Fort Kamehameha. The battery was completed in 1920, and this plan is dated March 24, 1921. The two 12in. m1895 guns sat in the circular aprons at either end of the battery. Batteries of similar design were used in many US ports. (NARA)



One of the powerful Army 16in. m1919 guns produced at Watervliet Arsenal, New York. The tube is being loaded onto the USS *Capella* at the New York Navy Yard in 1922, destined ultimately for Battery Williston, Fort Weaver. A year later the *Capella* participated in carrying relief supplies to Japan following the devastating Kanto earthquake. (AM)

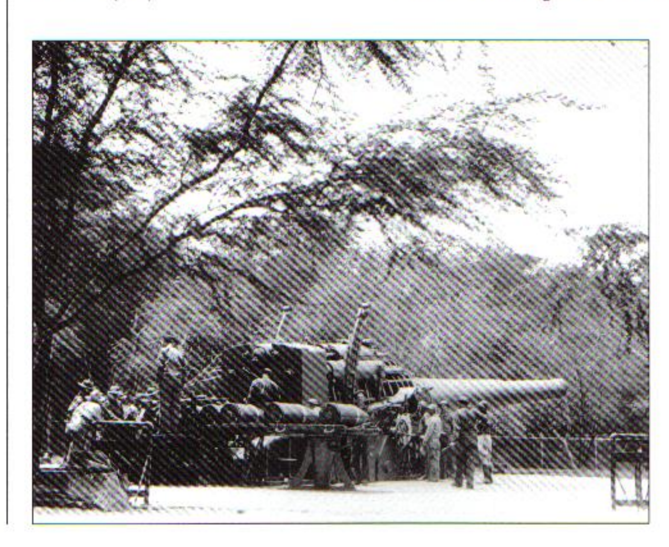
companies were organized into the 15th Coast Artillery (Harbor Defense) Regiment for the Pearl Harbor command and the 16th Coast Artillery (Harbor Defense) Regiment of the Honolulu command.

Somewhat offsetting this loss of weapons was an influx of mobile artillery assigned to the coast artillery. A variety of heavy weapons had been prepared for the World War I campaign in France by mounting them on wheeled and railway carriages. Some of these guns and the mobile coast artillery regiments to which they belonged were assigned to Oahu after the war. Given the numerous potential landing points around the island available for enemy attack, the use of mobile artillery, which could respond to a shifting threat, was particularly attractive.

In 1922 the United States became one of the signatories of the Five-Power Disarmament Treaty, also known as the Washington Treaty. While its primary clauses effectively limited the quality and quantity of naval vessels built and retained by the powers, it also included Article XIX, which restricted the construction of new fortifications in certain areas of the Pacific. For the United States this essentially meant that no additional defenses could be constructed west of the Hawaiian Islands – halting any significant augmentation of the fortifications in the Philippines or on Guam. At this time a shipment of twelve 240mm howitzers were at sea on the way to the Philippines for use as counter-battery fire weapons. The ship was returned to Honolulu, and the weapons off-loaded. These guns then became part of Oahu's armament. Prepared positions for the guns were constructed at numerous locations around Oahu, but mostly to cover the beaches and passes in the north, west, and east. These emplacements consisted of a circular track for the carriage trail around a central pintle for the gun base. The guns themselves were usually kept in storage. They were not assigned to a specific mobile regiment or unit: the plan was to emplace them only when needed, and to supply the gun crews from the existing fixed coast artillery units.

Railway artillery also found its way to Oahu during the years between the wars. Railway carriages for several sizes of gun had been developed for the World War I campaigns in France. In 1921 a railway unit reached Oahu, and was eventually reorganized as the 41st Coast Artillery Regiment (Railway). It was armed with eight of the standard 12in. m1890M1 seacoast mortars on railway carriages mounted on special narrow gauge rail cars. The plan was to use the guns as needed at various points around the island (the mainline Oahu Railway and Land Company line circled the island except for some regions on the western shore). Special short spurs were to be built for the weapons, and a branch line built to Schofield Barracks. While certainly powerful pieces, they were not viewed particularly well by the troops serving them. In 1934, 8in. guns were supplied to the 41st to replace the 12in. mortars. These too were older weapons, the standard seacoast 8in. m1888 gun, but the increase of elevation allowed by the railway carriage provided them with improved range compared to their original fixed seacoast carriages. Eighteen guns were supplied – two for a new fixed emplacement at Black Point, and 16 for the railway regiment. Organized into four batteries

Battery Williston, Fort Weaver. The 16in. guns and long-range barbette carriages are undergoing inspection by its crew, part of the 15th Coast Artillery Regiment. Ready rounds sit on the shell table, which is fed by service trucks on a narrow-gauge rail system from dispersed shell and powder magazines. This gun could fire a 2,340 lb shell some 27 miles, allowing it to hit targets anywhere on or around the coast of Oahu. (AM)





Firing practice at Battery Harlow, Fort Ruger, mid-1930s

Three 12in. mortar batteries (totaling 20 mortars) were utilized in Oahu's fixed defenses during the first half of the 20th century. This illustration shows Battery Harlow during firing practice; the battery was located on the northern flank of Diamond Head, being well shielded by the crater. There are four mortars in each rectangular pit. Emplacements like this were exercised during annual practice firings – as much to keep the crews trained and in readiness as anything else. The pit on the left is shown in firing mode, with mortars elevated and crew dispersed. The pit on the right is shown being reloaded, during which the guns and the adjacent magazines are a hive of activity, with men, loaded shell carts, rammers, and tools seemingly everywhere.

Key

A Loading platform
B Battery commander's station
C Plotting room
D Protected magazines and store rooms
E Concrete roadway
F Shell room
G Powder room
H Ante room
I Store room
J Office
K Miscellaneous equipment storage
L Protected passageway
M Underground power room
N Mechanical indicator devices

of four guns, good progress was made in the late 1930s in building the requisite sidings. Nine different locations were prepared around the island: by 1941 the regiment had batteries consistently based at the positions of Brown's Camp, Haleiwa, Puuiki, and the Mokapu Peninsula. While no longer actively serving, the railway mortars stayed in inventory at the Honolulu Ordnance Depot for potential emergency usage.

Oahu's air defenses were also supplemented by mobile 3in. m1918 anti-aircraft guns along with supporting mobile fire control and detection equipment, such as searchlights and sound devices. To man these truck-drawn AA guns, the 64th Coast Artillery (Anti-Aircraft) Regiment was based at Fort Shafter. The number of mobile AA units would grow to three regiments and 60 3in. guns by 1941.

The most useful item sent to the islands at this time was the 155mm towed gun. This weapon had been adapted from a World War I French design, the GPF (*Grande Puissance Filloux*). The gun had a good service record, and was well adapted to high-speed towing. It was usually emplaced in a prepared field position, or a more elaborate permanent position. The latter featured a central concrete pintle under the gun itself, and a circular track to allow the split trails of the carriage to traverse rapidly. Often a concrete or wooden/earth magazine was located nearby, as was a battery commander's station and plotting room. As this type of emplacement had been developed in the 1920s for American use in Panama, it was generally known as a "Panama mount." Arriving in several shipments, eventually the garrison had 51 155mm guns on inventory in late 1940. The unit using them was the 55th Coast Artillery Regiment, which was assigned to Oahu in May 1921. It was usually deployed in two battalions each of three batteries of four guns, the extra guns normally being in storage or sometimes assigned to additional battalions of other regiments. In the 1930s, 20 of the prepared Panama mount emplacements were authorized, initially being built adjacent to existing large-caliber batteries (Williston, Selfridge, Closson, at Fort Ruger and at Sand Island). In 1937 an additional 16 emplacements were built, and even more of them followed in the early 1940s.

Assignment to the Hawaiian Islands often meant encounters with an environment starkly different from life back home, as seen in this photograph taken in 1938 at Fort Shafter. (NARA)



The explosion of one of these 155mm guns was responsible for the worst peacetime accident in the defenses' history. On the afternoon of April 18, 1929 one of these guns exploded as it was being practice-fired by the 1st Battalion of the 55th Coast Artillery Regiment (Tractor-Drawn) at Fort Kamehameha. Apparently the charge detonated while the breech was being closed, probably due to a crewmember inserting a firing mechanism prematurely in order to speed up the loading process. The breechblock and block carrier were hurled 80ft to the rear by the explosion. Four crewmembers were killed, and ten others injured, two seriously. A local panel of officers immediately investigated the accident, and changes in training procedures were implemented.

Between the world wars, more heavy armament was provided for the fixed defenses. Following the building of Battery Williston at Fort Weaver, War Department plans had projected the emplacement of four naval 16in. guns centrally located near Schofield Barracks, which would allow them to provide all-round fire on targets throughout Oahu. Another result of the Washington Treaty had been the cancellation of a large number of American battleships and battlecruisers. Many of the 16in. guns for these ships had already been fabricated, and were excess to naval requirements. Most

were turned over to the Army. While not quite as powerful as the Army's own 16in. m1919 gun (as at Battery Williston), for the financially strapped Army of the 1920s and 1930s this transfer was immensely important to the modernization of its seacoast defenses. The standard m1919 barbette carriage could be easily adapted for this weapon. The supply of 16in. MkII barrels was enough to arm not only several new batteries built in the 1930s, but also all of the subsequent casemated 16in. batteries built by the United States during World War II.

After numerous local submissions and revisions, a single emplacement for two of the Navy 16in. MkII guns was authorized for construction on a new reservation at the southwestern corner of Oahu, on an elevated piece of land near Kapolei on the Ewa Plain. Eventually named **Fort Barrette**, this location was to be the site of **Battery Hatch**. Construction of the battery structures took place between July 1931 and late 1934. Service forces took possession on July 6, 1935 for an emplacement cost of $730,558 (plus another $41,000 for the combined plot and battery commander's station, and still another $114,000 for a separate series of eight magazines connected by a dedicated rail line). In many ways the battery's layout resembled that of Battery Williston. The guns and carriages were emplaced on completely open circular gun blocks. These were connected by rail line to a series of magazines – two powder and two shell magazines for each gun. A splinter-proof combined plot and battery commander's station was located behind and between the guns (which were over 1,000ft apart). Like batteries Closson and Williston the guns were protected only by camouflage netting and painting. As the gun barrels' useful life was only about 120 rounds and Oahu could only be supplied during war with considerable difficulty, the Army soon adopted a plan to store spare barrels for important batteries at the sites themselves (a practice also pursued for the Philippine defenses). In the case of Battery Hatch two additional 16in. tubes were dispatched to the site, and stored on elevated concrete stands not far from the service weapons.



This March 1934 photograph shows two types of supporting structures on Oahu: the tower of fire control station "X" built 1924 assigned to Battery Williston, and below this one of the new series of beach defense pillboxes only recently completed. (NARA)

Another additional fixed battery was built in this time frame. With the elimination of 5in. seacoast guns from the Army's inventories, Battery S.C. Mills at Kupikipikio Point (becoming known about this time as Black Point) was disarmed by 1925. There was still a need for a battery at this location, and it was decided to emplace two of the 8in. railway guns in a new battery position. **Battery Granger Adams** was built at this site from 1933–35, with the transfer being made in March of 1935 for $116,831. It was a relatively simple emplacement: the two concrete gun blocks (each mounting an 8in. m1888 gun on the top carriage of the m1918 railway barbette without the lower railway car) were on opposite sides of a protected powder and shell magazine. A battery commander's station and power room were also constructed.

By the late 1930s, funding improved with the beginning of the recovery from the Depression, and worries over the increasing level of military spending by Japan and Germany. The Hawaiian Department engineering section (aided by selective use of private engineering firms too) undertook a large variety of projects. Between 1907 and 1938, the Army had spent about $150,000,000 on the defenses of Oahu (twice as much as was spent on the naval base itself). Some of the more significant works added in the 1930s were as follows:

Beach defense pillboxes	The first 12 permanent, concrete beach pillboxes for 0.30cal. machine guns were constructed at vulnerable beaches around Oahu.
Aliamanu Ammunition Storage Depot	A large complex of tunnels and galleries was built on the western end of the old Red Hill reservation into the Aliamanu Crater for the storage of the Army's war reserve ammunition. Begun in 1933 with National Industrial Recovery Act money, its construction extended well into 1937 with over $1.6 million being spent.
Aliamanu Alternate Command Center	Wartime headquarters for the Hawaiian Department were tunneled in the north rim of the Aliamanu crater by boring one of the ammunition tunnels completely through the rim for a distance of 680ft. Branching off this main tunnel were laterals for power generation, mess areas, quarters, communications and command functions. Additions to the command tunnel system during the war turned this site into a huge underground facility.
Fire control stations	There was continued progress in constructing numerous stations, to support new batteries and to expand the fields of fire for existing batteries.
Harbor Defenses of Honolulu Command Post	This wartime headquarters for the harbor defenses, along with a radio and switchboard center, in the old "mule tunnel" through Diamond Head was completed in 1934 for about $30,000.

The US Navy was busy too. By 1938 the main channel into Pearl Harbor had been widened to 1,000ft and two new dry docks were added. The Lualualei Naval Magazine, a major new facility for ammunition storage 15 miles to the northwest of Pearl Harbor, was completed in 1934. Airfield expansion continued rapidly: **Ewa Field** (17 miles west of Pearl Harbor) was leased in the early 1930s by the Navy as a US Marine Corps air-landing base. The Navy also looked to move its major seaplane activities out of busy Pearl Harbor. Kaneohe Bay on Oahu's east coast provided the solution. Even though the water was shallow here, it was quite adequate for float and seaplanes. **Kaneohe Air Station** construction started in September 1939, and was a significant installation at the time of the attack in 1941. With the movement of the flying-boat squadrons, Ford Island became the Navy's principal land airbase for carrier aircraft, though it too soon became crowded and was replaced by the new **Barbers Point Naval Air Station** from November 1941. As World War II approached, the Navy modified its fleet deployment. In October 1939 it created the Hawaiian Detachment: it was initially composed of an aircraft carrier, eight cruisers, and 16 destroyers. These were permanently stationed at Pearl Harbor.

In April 1940 the Chief of Naval Operations sent the Pacific battle fleet to the Hawaiian Islands for annual maneuvers, then decided to retain them at Pearl Harbor as a deterrent to potential Japanese aggression. Since the early 1930s the Navy had been using Lahaina roadstead between Maui and Lanai north of Oahu as a protected deepwater anchorage for fleet deployment. While there were no support facilities on neighboring land, this location offered a convenient alternative to crowded Pearl Harbor for temporary fleet basing. Various plans were developed over the years for defenses (primarily minefields), but none were ever implemented. One of the important priorities for the Japanese just prior to the December 1941 attack was to have one of its seaplanes scout this anchorage to be sure that important naval units were not located there. For most of the interwar years the US Navy (sometimes with the Army participating jointly) conducted an annual fleet exercise. Several of these war games reflected fear of a potential attack on Hawaii. In 1925 an "enemy" fleet from San Francisco was to attack and seize Oahu. In 1927, another joint exercise was conducted with Oahu the objective. In 1932 and 1938 Navy carrier-based airplanes penetrated the island's local defenses during maneuvers. Through these exercises and annual war planning both American services were well aware of the concept of a naval carrier raid on the Hawaiian Islands.

The Army did not neglect airfield enhancements either: the first major expansion was the construction of **Wheeler Field** at Schofield Barracks reservation in 1934 to allow it to become the principal fighter field for the Army Air Corps. **Bellows Field** (originally called the Waimanalo Military Reservation) was developed around its single asphalt strip into a military airfield in mid-1941. It became the permanent station for the 86th Observation Squadron. **Haleiwa Field** in northern Oahu was also developed in the late 1930s as an auxiliary Army airfield. The air strength of the garrison also continued to improve in quantity. On November 1, 1940 the Hawaiian Air Force was activated. In February 1941 the 14th Pursuit Wing received P-36 fighters at Wheeler Field, and in May 1941 the first B-17s arrived to augment the strength of the 18th Bombardment Wing, stationed at Hickam Field.

The 1940 program

In September 1940, the US Army started its last major generation of coastal fortification construction. These were thoroughly modern defenses that were to provide the most powerful and systematic defenses for the country and its possessions. Unlike the previous systems, these structures were highly standardized and designed to withstand both naval and aerial bombardment, the engineers developing type plans to accommodate fewer weapon models. The 16in. gun was the standard heavy seacoast weapon, deployed in large dual batteries protected by massive concrete and earth overhead cover. The intermediate seacoast weapon was to be the 6in. gun. This gun (whether newly built or using the m1903 and m1905 barrels) was to be mounted behind a 4in. cast "tunnel shield," and provided with an overhead-protected magazine and supporting room complex. For a few, mostly territorial locations, an enlarged emplacement to carry an 8in. seacoast gun was developed. In 1943 the Army added type plans for the 90mm dual-purpose anti-aircraft and anti-motor-torpedo boat gun. Many of the previous generation's 16in. and long-range 12in. guns were to be modified with improved aerial and naval bombardment protection. Also the new-type emplacements were provided with protection from chemical gas attack – air locks and filters were provided for certain critical rooms in the designs. The older Endicott and Taft-era batteries would serve out until replaced by more modern constructions, eventually being disarmed and having their gun crews transferred to newer emplacements. Modern fire control (augmented by the recently developed radar), searchlights, and mining structures were used as required. Funding in 1940 began work that would eventually provide batteries in over 30 harbors. Each battery was initially assigned a project number, in order to distinguish and prioritize it prior to eventual naming. In fact the internal politics of naming batteries became so difficult during the war that the practice was



Fire control station "B" on the summit of Puu Palailai. This was a four-tiered building with stations staggered in echelon. The top station was the Battle Command Station; the others were secondary stations for batteries Williston, Closson, and Hatch. The first three stations were constructed in 1929, and the fourth (for Hatch) added in 1934. The site served through World War II, but is now abandoned. (TM)

suspended. Many of these batteries were never officially named, some being referred to by their construction number or a local, unofficial name.

Initially the plans for this new generation of coast defenses did not include the overseas possessions and territories; thus the Hawaiian Islands were not included in the priority list. However, Oahu did receive additional armament, firstly for the new Kaneohe Bay Coast Defense Project, and then to augment and modernize the intermediate defense of the rest of the island.

Prior to 1941, the Oahu defenses were subdivided into two harbor schemes; the Harbor Defenses of Pearl Harbor, and those for Honolulu. At times these defenses were kept under separate commands (involving different forts, batteries, and sometimes regimental units), and during other periods they were combined. With the development of Kaneohe Bay into a major naval air base (and with minor naval traffic), the need for a new harbor defense was identified. In April 1941 the Hawaiian Separate Coast Artillery Brigade initiated a study on the defense of this new naval air station and nearby Bellows Field. The first request was for two 155mm batteries, two of the newest-type 6in. batteries, and one of the new-style 16in. casemated batteries. Eventually the project also called for 90mm and 37mm AA guns, searchlights, radars, fire control stations, and a harbor defense command post. By late 1942 construction permission had been granted for a modified program, and work was under way.

Kaneohe Bay was to be protected initially by three new batteries. **Construction project number 301**, a battery for two 6in. guns, was built on a small bluff at the southern side of the reservation of the naval base itself. Using cut-and-cover techniques, a battery close to the new standard type was constructed. The two 6in. m1903 guns on M1 shielded barbettes were placed 210ft apart, with a protected magazine and power room intervening. Exterior walls were of 6ft-thick concrete, with interior walls 18in. thick. The battery commander's station was on the roof of the magazine, with the radar on top of that (the latter was built to resemble a water tank). The roof of the magazine was also 6ft thick, with another 3ft of earth covering. A small camp for the gun crew was built on the bluff behind the battery. Cost at completion was around $360,000.

Construction project number 302, also a battery for two 6in. guns, was built at Lae-o-Ka-Oio at the northern reaches of the bay. Unlike the practice on the mainland, the Hawaiian engineers showed great flexibility in modifying the plans to fit the local geographic conditions. The soft volcanic rock and rugged terrain lent themselves easily to tunneling – which in turn provided a lower cost and better protected alternative to the standard cut-and-cover designs. Battery number 302 was built into the face of a cliff, and featured concrete-lined tunnels leading to casemated gun positions. These casemates were as much to provide additional gun cover as to protect them from rock falling from above. The tunnels led back 150ft into the cliff, and had rooms projecting off at 45-degree angles for magazines and support facilities. The battery commander's station and the radar room were cut into the cliff 75ft above the gun level, being connected internally by stairs in a narrow shaft.

The third battery to defend Kaneohe Bay comprised a pair of 8in. guns. Emplaced on the slope of a hill to the rear of the military reservation, the plan was similar to that for a new-type 6in. battery. The battery was built as **construction project number 405**. The guns were not casemated, and while shields were being developed for this mount (they were in fact never acquired), they were mounted in the open with no protection from bombardment besides camouflage. Tunneled into the hillside behind the gun positions were the intervening powder magazines and shell rooms, along with power generation and storage rooms, and a plotting room. The three new batteries of this defense were not named until after the end of the war, becoming batteries **Forrest J. French**, **Avery J. Cooper**, and **Robert E. DeMerritt** respectively. The Army defenses around Kaneohe Bay were named **Fort Hase**.

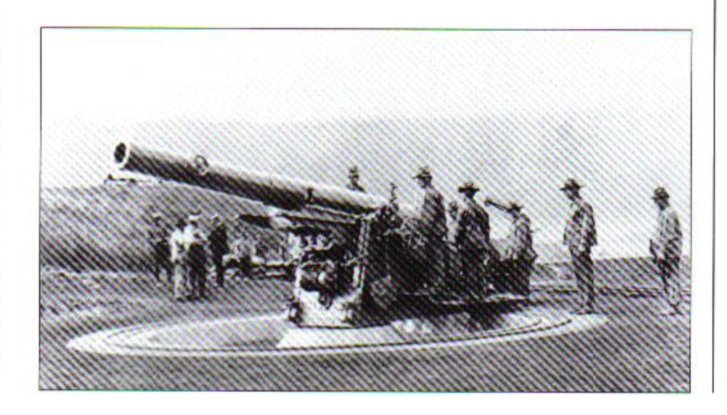
Fortress Oahu at war 1941–45

The attack on Pearl Harbor

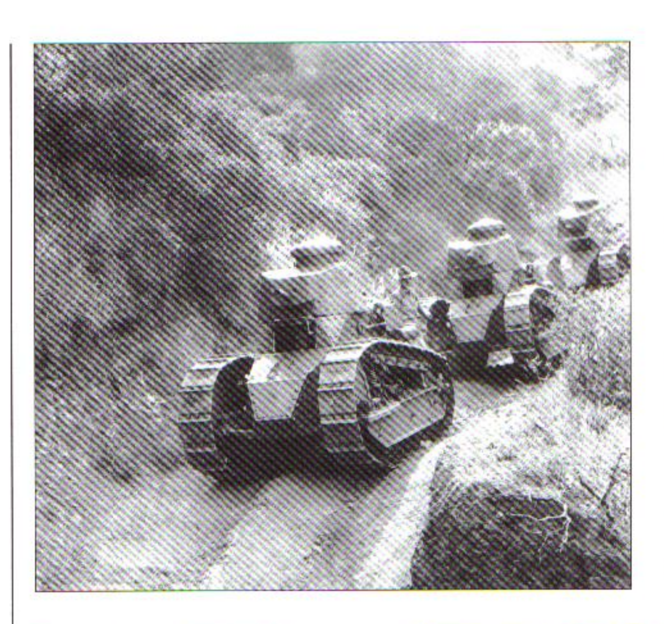
Most of the key aspects of the Japanese air raid on Pearl Harbor on December 7, 1941 are quite well known and discussed fully in other titles (see for example Campaign 62: *Pearl Harbor 1941*). The two aspects that directly apply to the local defenses are the degree to which the attack was anticipated and detected before delivery, and the direct effect on the defenses.

The US Army Hawaiian command and war plans department in Washington had long considered the potential of a surprise aerial attack on the base. It had been studied repeatedly in joint and separate tactical maneuvers in the 1920s and 1930s. The provision of anti-aircraft and air warning facilities, as well as stationing numerous pursuit aircraft on the island in the years immediately preceding the attack, attest to the concern. The first land-based radar units reached the Hawaiian Islands several months before the attack. Eventually six fixed and six mobile radar units were to be emplaced, but in fact just five of the mobile sets (all on Oahu) were operating by December 7. The station at Opana did detect the incoming flights of Japanese aircraft, but the command center dismissed the warning as a mistaken identity for the expected arrival of a flight of B-17 bombers from California. Earlier in 1941 a joint Army–Navy agreement (a good example of relatively rare inter-service cooperation) appointed the Navy as responsible for long-range aerial reconnaissance. Due to the availability of aircraft types and numbers (the Navy having PBY squadrons available, while the Army's access to long-range B-17s was much more limited at this time), the Navy agreed to supply scouting on a selected basis. Even though the Navy had over 60 planes available on Oahu there were not enough to conduct the continuous 360-degree, 800-mile patrols needed every day. Only a partial schedule on some days was possible, due to competing needs for inshore anti-submarine patrols, fleet exercises, training routines, and normal aircraft maintenance. On Sunday, December 7 there were only seven aircraft in the air, and none of these were on long-range search missions. Also on this date there was no organized visual air-warning network. The small size of the island did not lend itself to this sort of network: any potential enemy would be on top of the target by the time a visual sighting report made its way through the communications system.

The Army Air Corps on Oahu had not established a regular combat air patrol system. There were simply not enough available aircraft and trained aircrews to allow a continuous air cover capability. Some of the aircraft were clearly obsolete, and even the newer aircraft lacked spare parts and adequate maintenance. Also some of the recently arrived personnel were not yet fully trained, and did not possess combat readiness experience and discipline. On a relatively small island with concentrated potential targets, the best defense could be organized only with advance warning of a threat. The Army and Navy plans were too dependent on timely and accurate warning of the impending threat of war from higher command, and on the sighting of approaching enemy forces.



A US Army 240mm howitzer undergoing equipment trials in the mid-1920s. Twelve were at sea being shipped to the Philippines in 1922 when the signing of the Washington Treaty interrupted their journey: they were redirected to Oahu and used in prepared positions to defend beaches and other vulnerable locations. (NARA)



The 11th Tank Company long served as the Hawaiian Department's sole armored unit. Shown here is the 6-ton m1917 tank during 1929 field maneuvers: several types of tanks served with the unit over time though. (AM)

The Japanese launched two aerial attacks and coordinated mini-submarine attacks against the main target, the US Pacific Fleet in Pearl Harbor. They also attacked the Navy and Army airfields to insure that they would have control of the airspace above Oahu during the raid. As the Japanese were not planning either landings or naval bombardment of their targets, they made no direct attacks on the coastal, beach, or land defense elements on Oahu. However as several of the forts were immediately adjacent to airstrips, there were a few casualties and light damage. At Fort Kamehameha, immediately adjacent to Hickam Field, some stray strafing appears to have occurred, and one damaged Japanese aircraft crashed into the post's ordnance machine shop. Lt. William Sylvester became the first coast artillery officer to be killed in the war when his vehicle was strafed crossing Hickam Field to Fort Kamehameha. Also additional damage was done from falling American AA shells and shrapnel. At this fort, a total of seven servicemen were killed. Additionally at Fort Barrette at least one Japanese aircraft from the second wave strafed the post, killing a soldier there too.

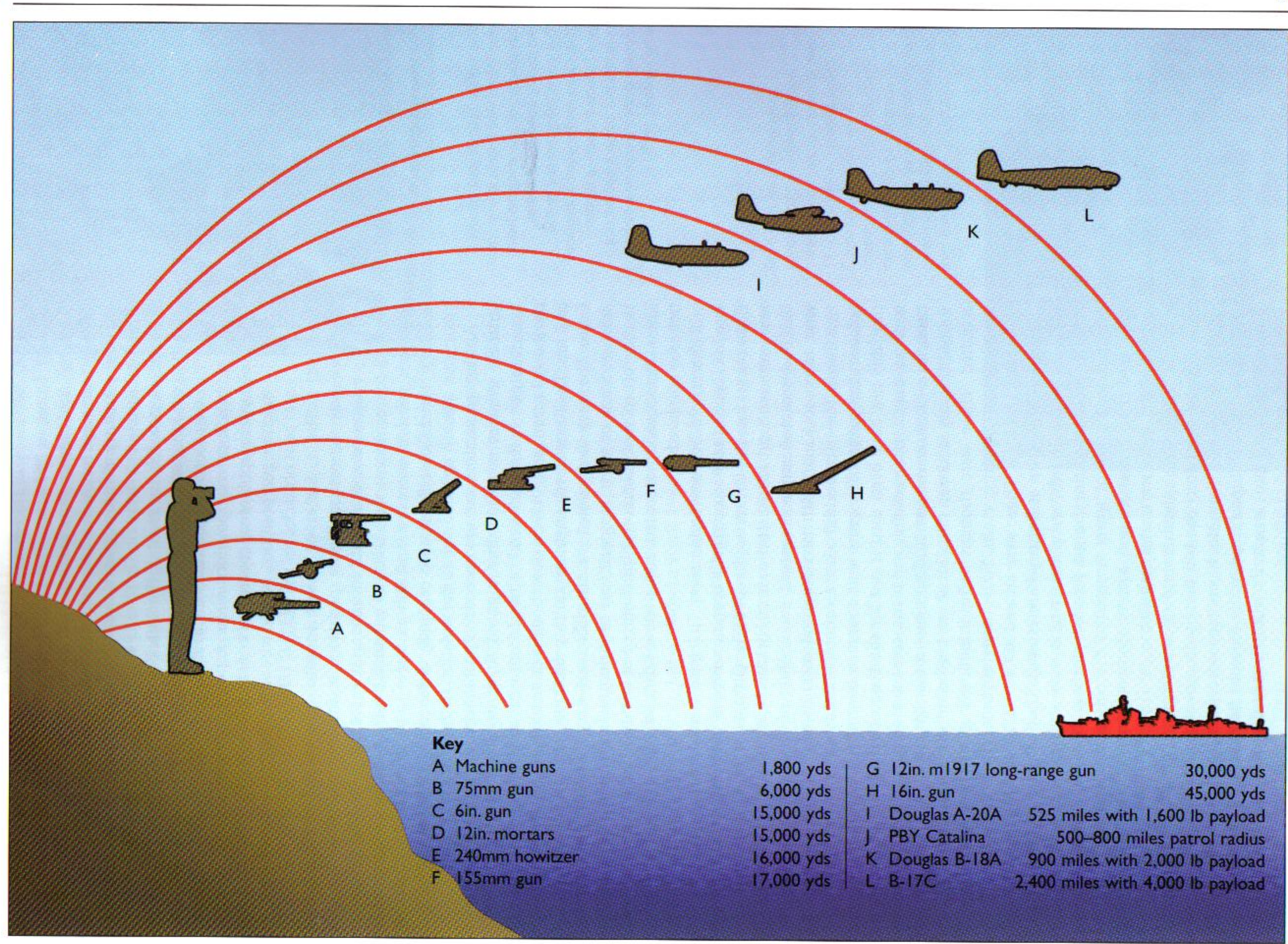
Immediately at the start of the Japanese attack attempts were made to get the anti-aircraft guns at the various Army posts into action. The Army experienced much of the same delay that the Navy sailors had on ship – Sunday-morning reduced personnel readiness, locked ammunition stores, and light guns not mounted. It took anything from 30 to 60 minutes to get the light AA machine guns into action; and because they were situated at posts not under attack, their ability to hit the enemy targets was very limited. The larger, 3in. AA guns of the 53rd Coast Artillery Brigade (AA) were up and firing near the end of the first wave, but again had little success. The Marines at the Fleet Marine Machine Gun School located at Fort Weaver performed better. They had their 0.50cal. and 20mm guns into action within ten minutes, and by some accounts are credited with shooting down four enemy aircraft. In general, the Army anti-aircraft batteries were too few, poorly located and not ready for a surprise Japanese air raid and therefore failed to provide any meaningful protection to the naval fleet or airfields.

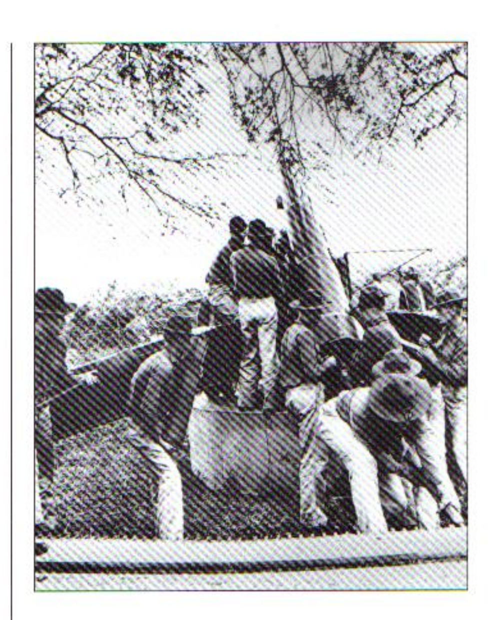
The Army Air Corps and its pursuit planes were also not ready for the sudden attack. Very few airplanes rose from the pursuit airfields to challenge the Japanese attackers. Most planes were grouped together to allow for protection against sabotage and were quickly damaged by the Japanese aircraft. Only a handful of Army planes made it into the air to defend the skies over Oahu.

By the end of the first wave, the coast artillery troops were beginning to disperse to their assigned defense positions. The heavy guns, fire control stations, and beach defenses were soon manned in preparation for landings that never came. The extremely high level of anxiety which existed, along with a tremendous number of rumors and fears of "fifth-column" or saboteur actions must have created an extremely confused period of days for the defenders. On the

The range and depth of Oahu's defenses, December 1941

Any attempted landing on Oahu's southern beaches in December 1941 would have been faced by a variety of defensive weapons. This illustration shows some of the major anti-ship and anti-invasion weapons, and the range they could cover. On any given day the number of units and their true readiness for use would vary, particularly depending on the ability to detect the approach in good time. Of course when the attack did come, it took the form of a carrier-based aerial raid, and not a landing or close-in naval bombardment.


A
B
C
D
E
F
G
H
I
J
K
L
Key
A Machine guns 1,800 yds
B 75mm gun 6,000 yds
C 6in. gun 15,000 yds
D 12in. mortars 15,000 yds
E 240mm howitzer 16,000 yds
F 155mm gun 17,000 yds
G 12in. m1917 long-range gun 30,000 yds
H 16in. gun 45,000 yds
I Douglas A-20A 525 miles with 1,600 lb payload
J PBY Catalina 500–800 miles patrol radius
K Douglas B-18A 900 miles with 2,000 lb payload
L B-17C 2,400 miles with 4,000 lb payload



The mobile 155mm guns received after World War I made an important contribution to upgrading the beach and landing defense capabilities. This gun is being manned by the 55th Coast Artillery, and is emplaced on a Panama Mount – a simple concrete pad within a circular ring allowing quick traverse on a stable firing platform. (AM)

afternoon of December 7 Fort Kamehameha was fenced-in for the first time in its history. The 41st Coast Artillery prepared to move out its 8in. railway guns, but was held up for most of the day due to bomb damage on the track line they were supposed to use. The Army's two infantry divisions (the Hawaiian Division having been reorganized into two divisions in October 1941) were deployed to their beach and sector defense, most of the 24th Division going to the northern part of Oahu, and the 25th Division being deployed to Ewa, Honolulu, and other southern sectors. In the first few weeks of war, many temporary beach defense positions were prepared. It seems that all potential landing spots were covered with field fortifications: these comprised machine gun positions, barbed wire entanglements, infantry trenches, and boat obstacles on the beaches.

For a period of several months, the return of the Japanese was viewed as highly probable. It was expected that the next Japanese attack would include an occupation or landing attempt, so urgent steps were taken to enhance the island's defenses. Significant reinforcements of land and air forces soon arrived, mostly from the West Coast. Some units originally destined for the Philippines arrived quickly, rerouted due to the isolation of those islands.

Artillery protection was also immediately enhanced. Maps found on downed Japanese aviators revealed surprisingly accurate detail about the location of American gun batteries. Several of the 155mm Panama mount positions were obviously known, and all were now thought to be too close to potential landing beaches. The Army's 34th Engineers quickly developed ten new positions around Oahu. The Navy soon offered the Army the temporary "loan" of guns for coastal defense. Some of these weapons had been in storage with the Navy at Pearl Harbor, others were taken off ships damaged or scheduled for armament change. These were quickly accepted and a new series of temporary or emergency batteries emplaced.

Thirteen old but serviceable Navy 7in. guns were contributed. These were 7in. Mk II guns that had originally been mounted as broadside casemates in the *Connecticut* class pre-Dreadnaughts of 1904. Only six were emplaced on Oahu: four were on Sand Island (just east of Hickam Field) in **Battery Harbor**, and two in casemated emplacements at Puu-O-Hulu on the west coast. Four guns were taken to Kauai, with two each emplaced in casemates at Ahukini and Nawiliwili. The batteries did receive concrete battery commander stations and adjacent magazines. The guns were found to be pretty well worn, and would probably not have been used if not for the state of emergency. By 1944 they were no longer seen as useful, and plans were made to replace at least the Oahu batteries with more modern and permanent 6in. batteries.

Additionally a dozen 5in./51cal. ex-battleship casemate guns were also acquired. These were thought to be suitable for guarding outlying beaches against small landing craft. Four batteries were constructed in January following the attack. These were located at Oneula, Ahua, Kahana, and Makua (the latter also known as **Battery Homestead**). They were bolted to a 2in. steel plate set on 2in. hardwood planks which were attached to a concrete block. Splinter-proof magazines, a gas-proofed plotting room, and either a battery commander station or tower completed the emplacement. One battery was later shifted to Nanakuli, and Battery Homestead was converted to 155mm guns. Smaller guns were contributed too. At least 11 naval 4in. guns were received. These were spread around on simple gun platforms, except for two that actually went into the old Battery Dodge at Fort Ruger that had been unarmed since 1921. Four 3in. naval guns were quickly emplaced on the north and south sides of Ulupau Head in the Kaneohe Bay defenses, and the two old 3in. m1903 Army guns originally from Battery Chandler were taken out of storage and emplaced at Wailea.

A similar process took place for improving the anti-aircraft defenses. Following the Pearl Harbor attack the Navy immediately mounted standard shipboard 5in./25cal. AA guns taken from sunken or damaged ships. Several of these were emplaced temporarily within the confines of the Navy yard. Early in 1942 they were transferred to Army control, which relocated several batteries. They were all emplaced on concrete gun blocks and had separate splinter-proof ammunition magazines and crew shelters. Eight battery sites were organized to hold these guns until they could be replaced by better armament later in the war. In the fall of 1942 numerous positions for automatic AA weapons (37mm or 40mm) were specifically emplaced around key airfields and in the city of Honolulu, including several locations atop the taller buildings downtown.

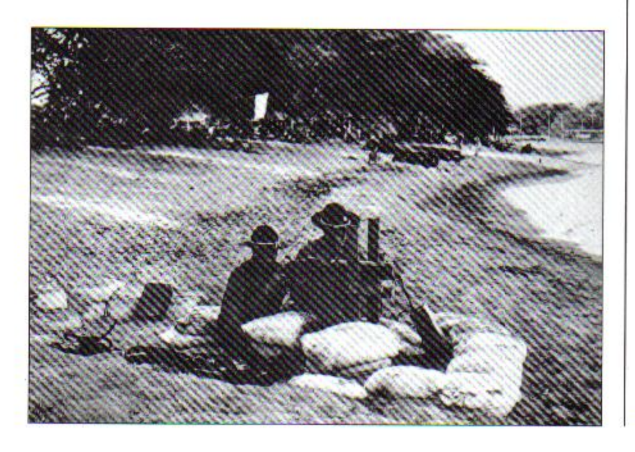
Wartime enhancements

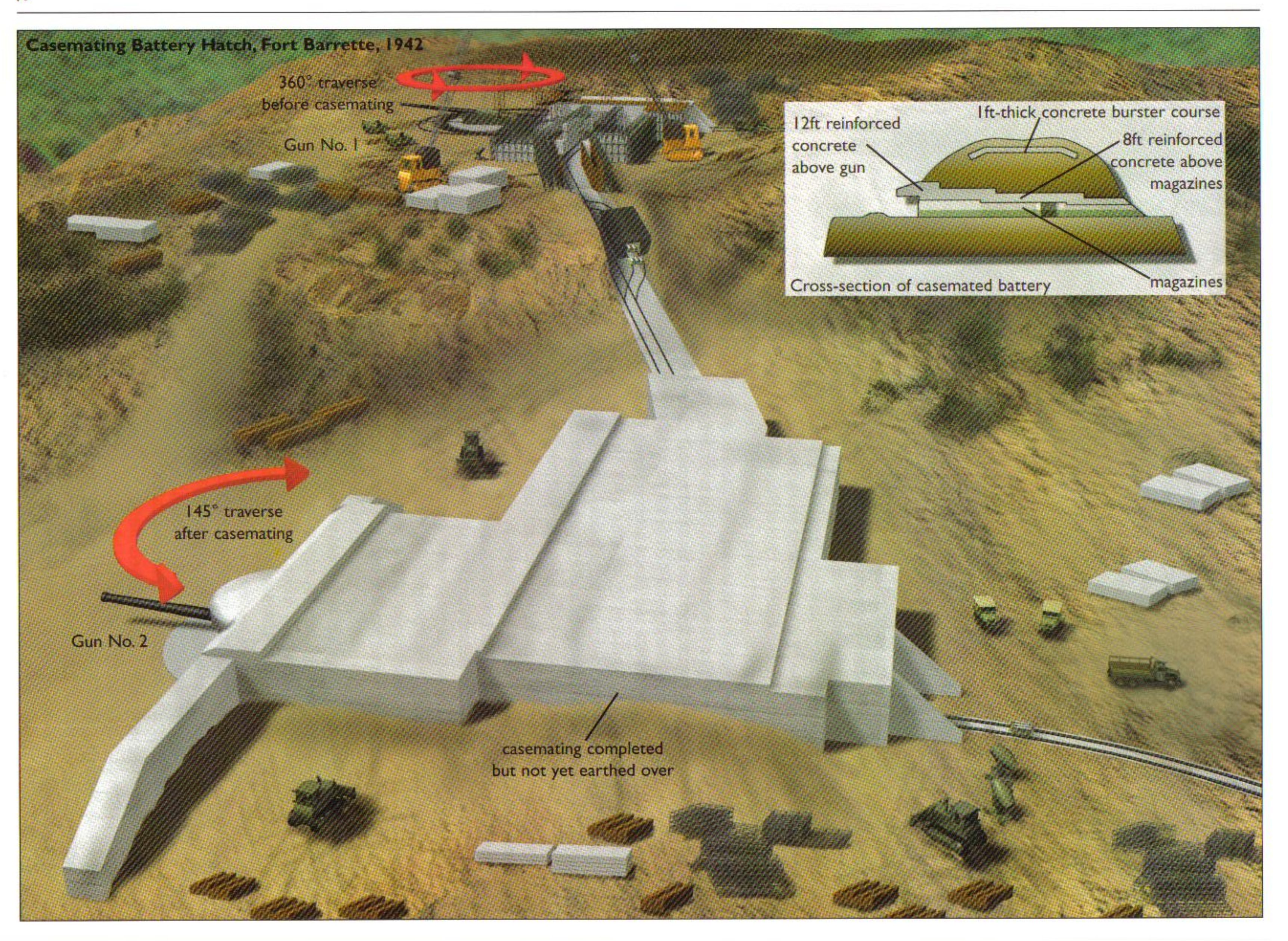
The general coast defense plans developed in 1940 had called for the use of new, intermediate-size gun batteries to help provide a perimeter defense in the waters around Oahu. The secondary mission was to deny the enemy entrance to Pearl Harbor, Honolulu, and Kaneohe Bay. The lack of any current defenses had made the Kaneohe Bay project a priority, but later in the war the Army turned to completing its other projects. In October 1943 the US War Department approved a plan for modernization of the island's secondary armament, resulting in the building of several new 6in. and 8in. batteries.

Battery construction number 303 was located on the western side of Oahu, the site selected to be at or near the volcanic rise of Puu-O-Hulu. This site had earlier received an emplacement of a pair of ex-naval 7in. guns, in the knowledge that it was best to update that position with a more modern pair of 6in. guns. The project included reworking the gun blocks, adding a new plotting and generator room, and installing better ammunition handling equipment in the magazines (which were tunneled into the steep volcanic rise of Puu-O-Hulu). Work was well under way by late spring 1944. **Battery construction number 304** was initially slated for Sand Island, but a study in April 1944 switched its position to Punchbowl Crater above Honolulu. The tunnels were drilled through the southern rim of the crater. The two 6in. m1903 guns on M1 shielded carriages were emplaced an unusual 320ft apart, being connected by internal tunnels 10ft by 12ft in dimension. The gun positions were casemated, though this battery was never completed. The last 6in. position was **Battery construction number 305**. Originally designed to replace 6in. Battery Dudley at Fort DeRussy, its final location was at Koko Saddle, in the mountains above the coast southeast of Fort Ruger. Surveying work was done, but problems were encountered with the soil conditions, causing the project to be cancelled.

The War Department turned down a local request for three additional dual 16in. casemated batteries. However in January 1944 authorization was given for three more dual 8in. barbette batteries to function as partial substitution for the denied heavy batteries. The dual 8in. battery for the south shore started at this time was **Battery construction number 407**, on the south side of Diamond Head Crater at Fort Ruger. While work was not started until 1944, considerable progress was made. Like the battery at Punchbowl, it featured tunnels cut through the crater rim, resulting in internal entry portals, and exits into casemated positions covering the unshielded guns. These tunnels and the lateral connecting them were completed with concrete lining of the internal walls. Progressing much more slowly were the two batteries for the north coast, **Battery construction number 408** at Paumalu (Waialee) and **Battery construction number 409** at the northwest extreme of Oahu at Kaena Point. Battery number 408

On Oahu, local Army units continuously conducted beach defense exercises, as shown in this 1927 exercise at Haleiwa Beach. Concrete pillboxes were constructed at certain locations, but the Army assumed adequate warning prior to any attack would permit the building and manning of field fortifications. (NARA)




Casemating Battery Hatch, Fort Barrette, 1942
360° traverse before casemating
Gun No. 1
12ft reinforced concrete above gun
1ft-thick concrete burster course
8ft reinforced concrete above magazines
magazines
Cross-section of casemated battery
145° traverse after casemating
Gun No. 2
casemating completed but not yet earthed over

was never started, and Battery number 409 had some of its tunnels bored into the rock, but was then indefinitely suspended at only two percent completion.

In addition to new battery construction, important projects were started for the modernization of the primary long-range batteries built in the 1920s and 1930s. Providing overhead protection from aerial bombardment for batteries Closson, Hatch, and Williston was considered urgent. In fact a general US War Department project for the design and modification of these emplacements was started prior to the Pearl Harbor attack and the American entry into the war. In general this protection meant adding a casemated room around each individual gun emplacement. For protection from 1,000 lb bombs, the roofs over the guns needed to be 8ft-thick reinforced concrete, and additionally covered with up to 20ft of earth. At Battery Closson work was soon under way, but encountered soft ground and settling which fortunately was allowed for in the design. The opportunity was taken to add frontal shields to the guns and power rammers for reloading. Radar for fire control was added in the same project. As the guns were relatively close to the magazines, it was easy to configure this as a single structure – the casemates being simply new "rooms" added to the length of the intervening magazine structure. A different problem was encountered at Battery Hatch where the distance between guns was over 1,000ft and the magazines were dispersed. Large individual casemates were started in early 1942: the separate power plant and switchboard room was given additional splinter-proof protection.



Mobile railroad artillery arrived to bolster Oahu's defenses between the wars. Here 12in. mortars on specially reinforced railcars (gauged to fit the island's existing track system) are being test-fired from prepared sidings. (AM)

The drawback with these designs was the severe restriction they placed on the field of fire. At a mainland location it usually didn't matter, but on an island such as Oahu, where the capability of firing to the rear meant additional coverage against beach landings, the price was a heavy one. Early on it was decided not to provide casemated protection to Battery Williston at Fort Weaver. This would mean that the heaviest, longest-range guns could still fire over virtually the entire perimeter of Oahu. The plans for the guns themselves specified that they be equipped with long, 2in.-thick steel armored shields. Much of this work was done, but the shields were delivered with some flaws, and even when corrected were never erected. As late as September 1944 authorization was sought to casemate the battery, but since relocating the guns to near Aliamanu Crater was under consideration, this was not done either. When it finally ended service, after the war, Battery Williston's guns were still in their original dispersed, open condition.

Local fortification programs in early 1942 also saw splinter-proof protection, gas proofing, and bomb-blast walls built at the older batteries, including Randolph, Selfridge, Dudley, Jackson, Harlow, Hasbrouck, and Granger Adams.

Casemating Battery Hatch, Fort Barrette, 1942

The 16in. guns of Battery Hatch, Fort Barrette, were given massive overhead protection during 1941–42 using reinforced concrete, a process known as "casemating." Each structure contained a gun room (34ft x 51ft), two powder rooms (15ft x 73ft), two projectile rooms (12ft x 18ft), and a storeroom (10ft x 17ft). The concrete walls were 10–12ft thick. Above the magazines was 8ft of reinforced concrete, and this increased to 12ft over the gun itself. The structure was then capped with up to 24ft of earth, and a 1ft-thick concrete burster course (designed to detonate bombs or shells and absorb their explosion without harming the main structure). The trade-off for this increased protection was that the guns' previous 360-degree field of fire was reduced to just 145 degrees. The illustration shows the No. 2 gun casemate completed but as yet uncovered by earth, with work under way on the No. 1 gun position: in reality, both were casemated simultaneously. Both guns kept their weapons in service throughout the work.

One defensive measure that was not upgraded during the war was the submarine minefield. In May 1942 it was decided that the physical characteristics of Pearl Harbor did not lend themselves to controlled mines, and the large number of friendly-vessel movements meant that such a field could be dangerous. No controlled mines were operated on Oahu during World War II.

During the war the production of newer types of anti-aircraft guns allowed for the upgrading of the original AA defenses. The new standard weapon was the 90mm dual-purpose gun, adopted by the coast artillery to serve both as an anti-aircraft weapon and for anti-motor-torpedo boat (AMTB) service within fixed defenses. Starting in the spring of 1942 these guns replaced most of the fixed and mobile 3in. AA mounts. Under a 1943 authorization, Oahu was to receive six of the new 90mm AMTB batteries, usually of two fixed guns on concrete blocks and two mobile guns. Batteries went to Sand Island, Ala Moana Park, Fort Kamehameha, Fort Weaver, and Fort Hase and Kualoa defending Kaneohe Bay. Additional work started late in the war on positions for the new 120mm AA gun and several batteries were armed with this weapon.

The reinforcement of the islands became a clear priority immediately following the December 7 attack. The easiest deficiency to rectify was the number of heavy bombers present: they could fly directly from California to Oahu. As several squadrons of B-17s were already on the US West Coast preparing for dispatch to the Philippines, it was simple to divert these planes to Oahu. By December 21, 1941 there were 43 of the bombers in active service at Hickam Field. The rebuilding of the pursuit groups was more difficult. For a period after the attack the US Navy halted any independent sailings of cargo vessels to the islands: convoys were not able to start up until January 15, 1942. Crated P-40s received priority shipping, and by the end of January creditable levels of active fighter aircraft were back on the islands.

General Emmons, replacing General Short who was soon relieved of command, quickly requested an additional "square" division, two more coast artillery AA regiments, and over 10,000 service troops. The 27th New York National Guard Division was dispatched, but this was not until March and April of 1942 after performing guard duty around key industrial and military sites on the West Coast. It was basically deployed on the outer islands, with most troops stationed on Hawaii itself. Among the first units to arrive were the 57th and 95th Coast Artillery (Anti-Aircraft) regiments, substantially adding to the personnel and AA capabilities on the islands. Large stocks of 0.50cal. ammunition and aerial bombs were also among the early cargo to arrive on Oahu following the attack.

However, at that same time that this reinforcement was being implemented the perception of immediate danger was diminishing. By Christmas 1941 military opinion had begun to dismiss the likelihood of an organized Japanese landing on the islands. While additional raids were still possible, it was obvious that the majority of the Japanese resources were being deployed to the southwestern Pacific and the campaigns in the Philippines, Malaya, and the Dutch East Indies. The flow of American war *matériel* for the Pacific campaign began to be directed to Australia and the southwest Pacific. For the balance of the war though the Hawaiian Islands, and particularly Oahu, were still seen as an exposed base that could receive enemy attention with relatively little or no warning. Although the threat decreased, particularly as Allied successes drove the Japanese further away, the active defense of the island and the major operating base never ceased. Until the end of the war in 1945 the coast defense batteries, the pursuit squadrons, and the infantry regiments stayed alert and ready to serve.

Underground facilities

Another major area of wartime development was a concentrated effort to build tunneled or underground command centers and key facilities. These were constructed on Oahu by a variety of organizations for protective purposes. Some of the most noteworthy are listed below:

A combined Army–Navy operations center built following the Navy's request in October 1941, an expansion of the Army's own center in Aliamanu Crater. Over 34,000ft^2 of tunnel space with air-conditioning and a major telephone switching room included.

A North Sector command post in Poamocho Gulch near Schofield Barracks, built between November 1941 and January 1943. Its primary feature was a two-story cut-and-cover bombproof structure.

The new Pearl Harbor – Harbor Defense Command Post: a 15ft x 211ft tunnel at a new site near Salt Lake.

A command post for the 18th Bombardment Wing in Aliamanu Crater: this was structurally distinct from the joint Army–Navy center and the ammunition depot.

A South Sector command post in a tunnel at Aiea, holding over 4,100ft^2 of administrative space.

Kaneohe Bay Harbor Defense Command Post at Ulupau Crater, not far from where Battery Pennsylvania would be completed. This was completed by late 1943.

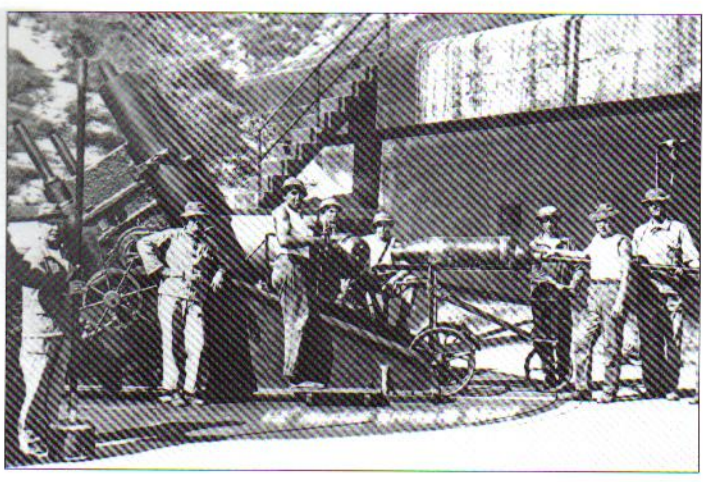
A major underground fuel depot on the Red Hill reservation.

Several very large underground aircraft assembly and maintenance facilities at the Schofield Barracks reservation.

The naval turret projects

The significant impact of the Japanese attack on military thinking can clearly be demonstrated by the naval turret projects. These final coast artillery batteries for Oahu are also among the most interesting and technically sophisticated fortification projects ever launched by the United States. While the Army

was actively looking for ways to quickly augment the conventional artillery defenses of Oahu following the attack, the Navy came forward with an offer that seemed to solve the problem immediately. Excess naval turret mounts were soon to become available, and the Navy wanted to know if the Army was interested in obtaining these for coastal defense. Eight dual 8in. gun turrets were scheduled for removal from the naval aircraft carriers USS *Lexington* and USS *Saratoga* in February 1942. Also it seemed possible that at least some of the turrets from the sunken battleship *Arizona* could be salvaged and turned over to the Army. Both of these offers were quickly accepted.



A fine close-up view of one of the m1908 mortars, shell cart and round, rammers, and crew of Battery Hasbrouck, Fort Kamehameha. The informal dress of the crew is representative of the mid-1930s period. (AM)

The Washington Naval Treaty of 1922 had allocated tonnage for aircraft carriers, and at the same time restricted new battleship and battlecruiser construction. It was possible though for several countries to convert partially completed capital ships to heavy carrier designs. Two battlecruisers, the *Lexington* and *Saratoga*, were eventually completed as the first American large fleet carriers. This same treaty stipulated the maximum size for guns in the carrier category at eight inches. Prevailing naval doctrine foresaw that carriers might have to defend themselves against marauding cruisers, and thus these ships were completed with four dual 8in. gun mounts (only lightly splinter-proofed, the Navy never referred to these as "turrets," rather as "mounts"; while the Army's use of terminology wasn't so precise). The mounts were positioned two fore and two aft of the large stack superstructure on the starboard side of the landing deck. The guns were naval Mark IX 55cal. rifles, similar to those mounted on the *Pensacola* and *Salt Lake City* heavy cruisers. These guns were occasionally exercised in target practice, but the concept of independently sailing carriers was fading. By mid-1941 a decision had been made to remove these mounts and to use the space to provide a like number of 5in./38cal. dual-purpose guns to significantly enhance the heavy anti-aircraft capabilities. When the *Saratoga* was torpedoed by Japanese submarine *I-19* on January 20, 1942 it returned to Pearl Harbor for emergency repairs prior to moving on to Bremerton for more thorough repair and modification. The four 8in. mounts were quickly removed at Pearl Harbor. *Lexington* had her guns removed in late February when she made a routine stop at Pearl Harbor. The *Saratoga* had new 5in. guns installed in Bremerton, but the *Lexington* was lost at the Battle of Coral Sea before her new guns could be mounted.

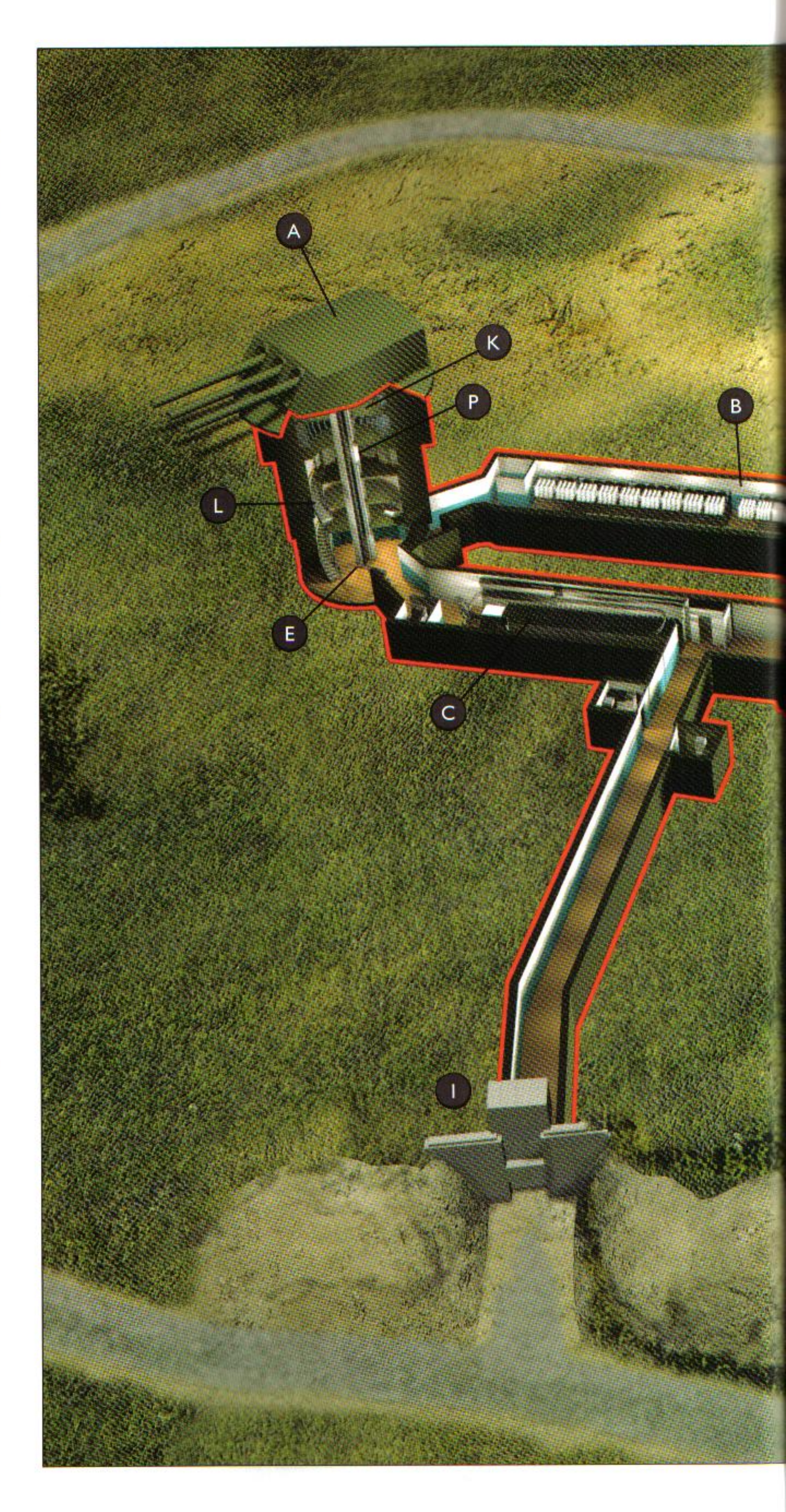
The Hawaiian Department was offered these mounts on January 17, 1942 by the Commander-in-Chief Pacific Fleet; and by February 4 not only had the Army agreed but sites had also been tentatively selected. The decision was made to mount these guns as four two-turret batteries (thus four guns per site), all placed well back from the shoreline and preferably at elevation to form a second line of defense for Oahu if needed. *Saratoga*'s mounts were to go to Brodie Camp and Salt Lake, covering the north and south shores respectively. *Lexington*'s mounts (whose removal work, in line with the availability, trailed *Saratoga*'s by about two months) went to Opaeula and Wiliwilinui Ridge also covering north and south respectively. The latter location was the only one relocated from initial selection. The work was pressed with the highest priority. Crews were authorized for 24-hour work, waivers even being issued for nighttime use of lights during the otherwise blacked-out Oahu. The emplacements were completed by the end of 1942, and proof fired as finished from August to December. The Salt Lake site was named **Battery Burgess**, Brodie Camp as **Battery Ricker**, Opaeula as **Battery Riggs**, and Wiliwilinui Ridge as **Battery Kirkpatrick**.

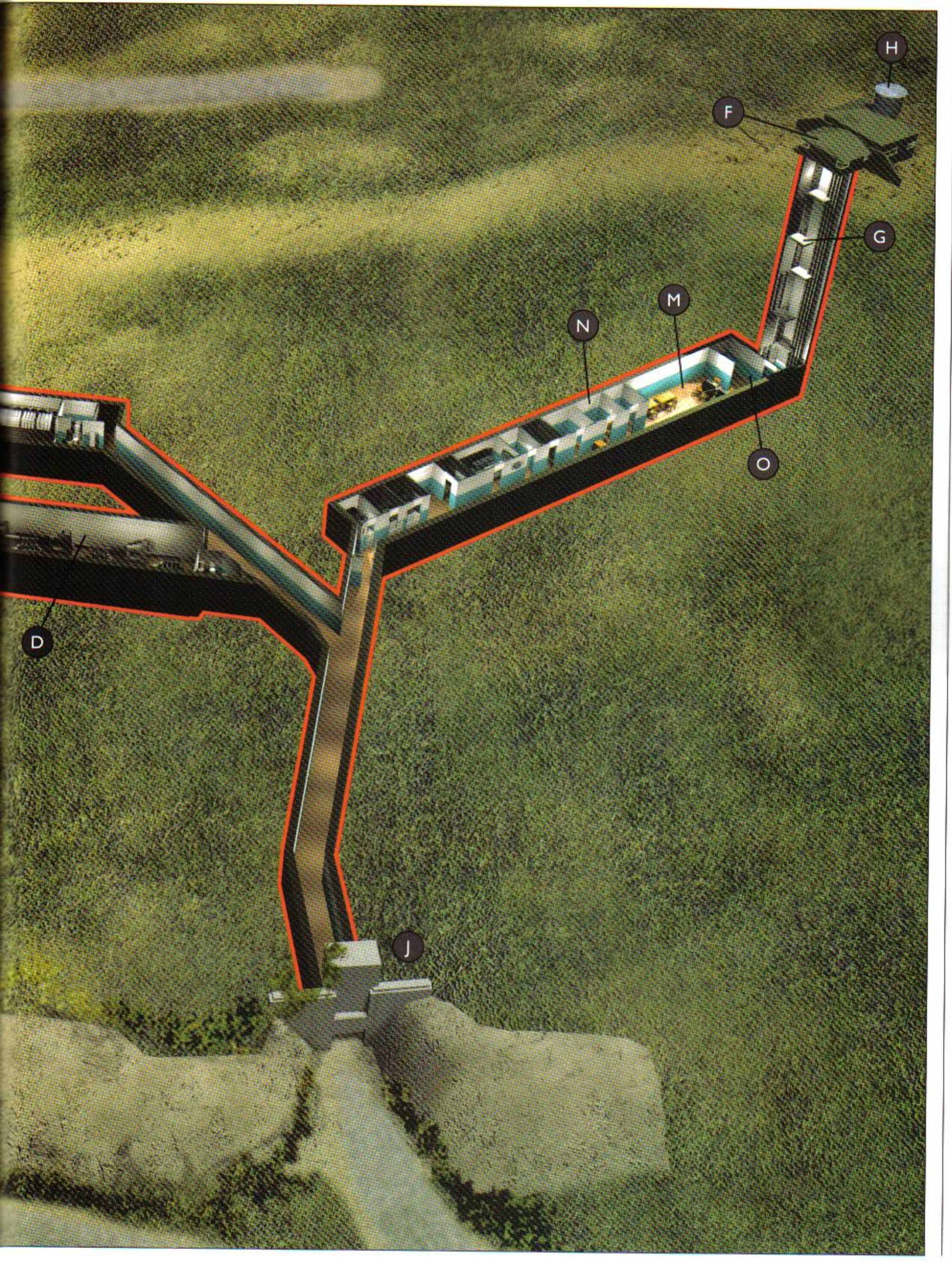
Battery Arizona

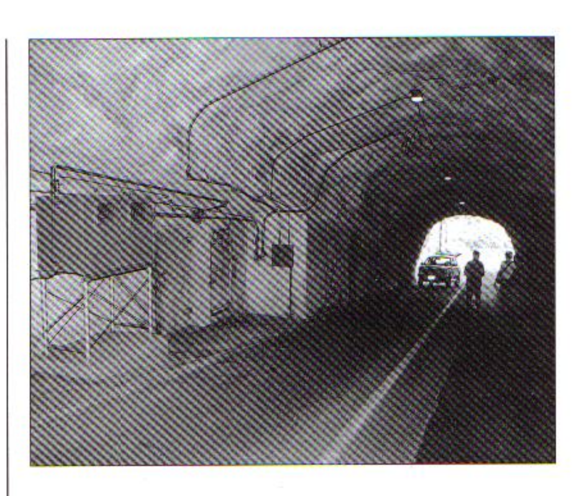
Following the attack on Pearl Harbor, the US Navy offered, and the Army accepted, the use of two of the triple 14in. turrets from the sunken USS *Arizona*. They were to be used in coastal artillery batteries, considerably augmenting the pre-existing armament. One turret went to eastern Oahu at Kaneohe Bay (to be named Battery Pennsylvania, the sister ship to the *Arizona*), and the other (shown here) to the western side of the island near Kahe Point (to be named Battery Arizona after the turret's source). Work on the site and in reconditioning the turret was extensive, probably one of the most complex engineering tasks undertaken in the islands during the war, although it was never fully completed. This illustration shows the battery as it looked in late-1945, with just the turret showing above ground, and the complex of powder, projectile, power, and service rooms beneath the surface.

Key

- A Triple 14in. gun turret from USS *Arizona* (325ft above sea level)
- B Powder magazine
- C Projectile magazine
- D Power room
- E Ammunition hoists
- F Battery commander's station (340ft above sea level)
- G 70ft-deep shaft, in six 12ft laddered sections
- H SCR-296 radar antenna
- I Western road entrance
- J Eastern road entrance
- K Shell-handling deck
- L Staircases inside barbette wall
- M Plotting room
- N Radio room/switchboard
- O Radar room
- P Powder hoist




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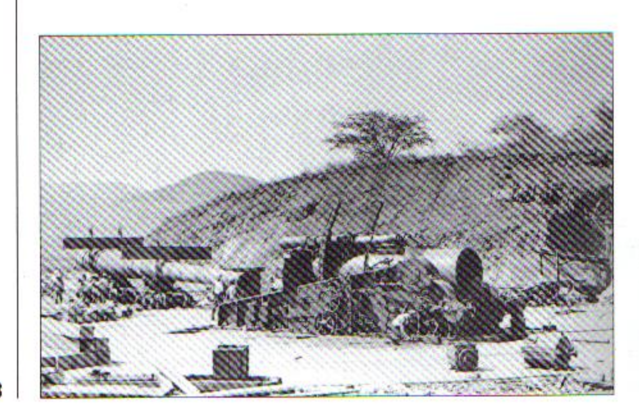
This 1994 image shows the entrance to the Harbor Defense Command Post for the Harbor Defense of Honolulu. It was located in the enlarged "mule" tunnel passing through the Diamond Head Crater at Fort Ruger. This tunnel was constructed in 1909 to allow mules hauling construction material access to the crater and up Leahi Peak. In 1932 it was enlarged to a width of 15ft and a height of 17ft. On one side about 50ft in from the north portal a large cavern was created to contain rooms for plotting, operational control, radio contact, a switchboard, a message center, and emergency power generation. (TM)

The adopted site plan mounted the two turrets separately in self-contained emplacements. The turret mount itself was the only part of the battery exposed, sitting on a concrete, circular barbette. Underground, this barbette opened into two lateral galleries, one for projectiles (10ft x 30ft) and one for powder (12.5ft x 30ft). A shorter entry tunnel lay off the vertex of each gallery. Supporting both emplacements were a splinter-proof battery commander's and director building, an underground plotting room, a bombproof generator room, and a separate SCR-296 radar facility. The mounts were electrically powered but in emergency could be managed manually. Each turret was supplied with underground magazine space for 250 rounds. A separate powder magazine for another 600 rounds was built: the reserve projectiles were stored outside in racks. The original fire control plan was to use the Navy optical directors from the carriers, but as these did not lend themselves to indirect (non-visual) fire, they were replaced with the Army's normal fire control system later in 1944. While the gun mounts were only very lightly armored and thus somewhat vulnerable, the coast artillery command in general was very satisfied with these emplacements. They certainly became available at the right place and time for their utility, but also compared well with the contemporary Army designs of the 1940 Modernization Program.

A much more ambitious project originated with the turrets from the USS *Arizona*. The ship had settled on an even keel after the explosion of her forward magazine from the Japanese dive-bomber hit on the morning of December 7. It initially appeared that the two aft turrets (No. 3 and No. 4), and perhaps even the lesser damaged of the two forward turrets might be salvageable. The possibility of these being made available was raised at about the same time as the offer of the 8in. mounts, on January 16, 1942. Even though much discussion was to follow, and the official project was not formally approved until August 13, 1943, the US Army moved quickly to investigate sites and emplacement designs. By October 1942 it was clear that only the two aft turrets would be usable. Earlier, in July 1942, a decision was made to emplace these as single-turret batteries (of three 14in. guns); one to reinforce the Kaneohe Bay defenses (this turret site would latter be named **Battery Pennsylvania**), and one for regional protection on the southwestern side of Oahu to cover the Lualualei Ammunition Depot (this turret site would later be named **Battery Arizona**). The design studies and work to clean, repair, and rehabilitate the turret and gun parts removed from the USS *Arizona* wreck soon began.

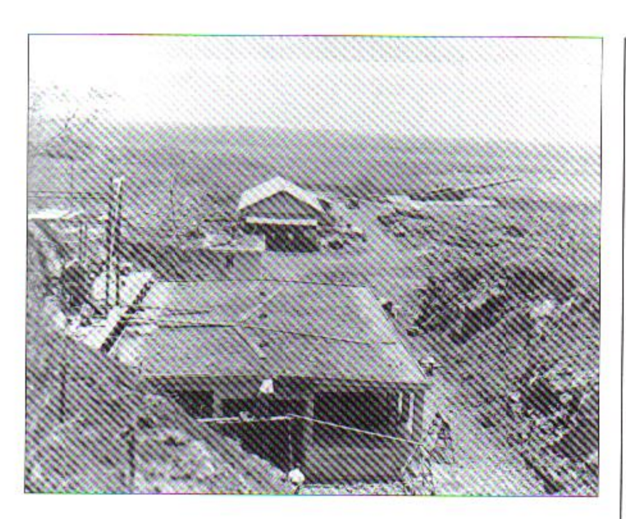
This was a significant engineer and ordnance project, involving much work by both services. The US Army had little experience with this type of emplacement, especially how to load ammunition using handling hoists from a battleship. Some of the parts were damaged in the attack, and all had been submerged for several months. Much of the original removal work had not been done with thought of potential re-use; some of the parts were cut in the wrong places or otherwise damaged. The mechanisms were almost 30 years old: a detailed set of plans were not available at first, and even when finally obtained in late 1943 it was found that years of modification had made certain sections unusable. In March 1943 a centralized coordination office was set up for the project, involving technical supervision from both services. A major Pearl City warehouse work-yard facility was set up to assemble and repair parts. New parts had to be machined as far away as the US Navy Gun Factory in Washington, D.C. At times the project was held up due to a lack of technically

The m1919 barbette carriage awaits its 16in. MkII M1 Navy gun (seen in the background) at Battery Hatch, Fort Barrette. The barrel will be inserted into the carriage's slide and the breech will then be attached. The massive size of this weapon required special tools, skilled mechanics, and adequate time to install. (NARA)



skilled workers. Some of the skills needed were only possessed by a limited number of technicians who were also needed on other important projects. However, by the end of 1944 the emplacement's construction was virtually complete. At that time Battery Pennsylvania at Mokapu Head was 75 percent complete and engaged 58 workers, while Battery Arizona at Kahe Point was 67 percent complete with 55 workers on site. Battery Pennsylvania was hurriedly completed so it could proof fire in August of 1945 at the very end of the war. Battery Arizona was slightly behind, and never brought to final completion or proof firing.

The two emplacements had numerous features in common, but the details varied considerably with the local topography. Battery Pennsylvania was sited on the crest of the Ulupau Crater. The steepness of the crater constrained the underground features of the emplacement. Battery Arizona had more room for its layout. Both featured the triple turret on a central concrete barbette embedded in rock. Considerable debate had taken place on the ability of volcanic rock to take the load of these turrets and their firing, but as it turned out this was not a problem. The barbette had an outside diameter of 24ft, and descended 60ft into the ground. Lateral tunnels for ammunition and support rooms spread from the base of the barbette. The layout of these rooms varied with each site plan. Large powder and projectile storage rooms were built to hold 840 rounds per battery. A large power room with three 125kW diesel generators supplied power to each emplacement. A separate tunnel with a 10,000-gallon water tank was also included. Latrines, a first aid room, and a small gallery were included for the projected crew of four officers and 157 enlisted men. The usual complement of radio, switchboard, plotting, radar, battery commander's station, tool, and storage rooms were included. A special problem arose with the ammunition lifts. Because the barbettes extended 60ft down (to meet an Army requirement of a minimum of 40ft of overhead earth cover), they were deeper than the corresponding naval hoists from the *Arizona*. A two-stage lifting arrangement had to be designed, essentially to carry powder and projectiles from the lower magazine to a handling room where they could be put on the ex-naval hoists to the gun breeches.



Completing one of the dispersed magazines for 16in. Battery Hatch at Fort Barrette, in an image taken July 16, 1934: one of the guns has already been mounted. (NARA)

While the turret battery range of 32,000 yards was somewhat less than the 16in. emplacements, the protection of the guns themselves in their turrets was significant. Postwar recommendations were heavily biased toward utilizing turrets in all major future projects. For a short period of time in 1943 it appeared that the four turrets of the capsized battleship USS *Oklahoma* would become available to the Army. The *Oklahoma* was of a class previous to the *Arizona*, and while it carried the 14in. guns, they were in two triple and two dual turrets. The Army projected emplacing the dual mounts at Makapuu Head on the southeast corner or Oahu and at Paumalu on the north shore. The triple turrets would go to Kaena Point on the western tip, and on the south face of Diamond Head Crater at Fort Ruger. It was soon found that the turrets were beyond salvage, and the Navy wanted to keep the individual gun tubes as replacements for the fleet. Even this plan was not the final scheme for using ex-Navy turrets. As late as 1946 correspondence was exchanged concerning the potential use of triple 16in. turrets from the canceled battleship USS *Illinois* on Oahu. By that time however, such a project was well beyond both the need and financial resources of the postwar Army.

US Army Air Corps Douglas B-18 bombers at Hickam Field. The 18th Bombardment Wing received this strike aircraft in the late 1930s, and while still present in 1941, it was considered obsolete and was undergoing replacement by the far more capable B-17. (NARA)

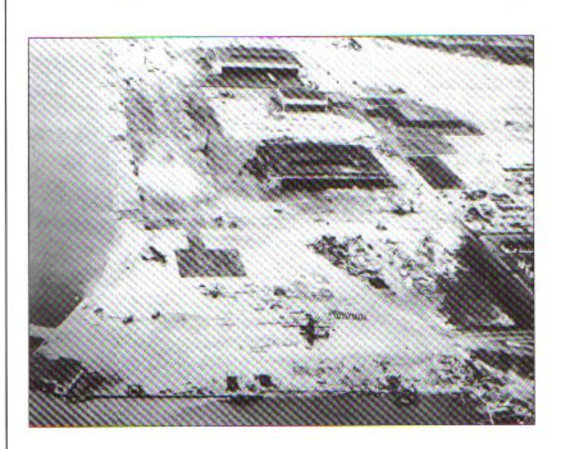


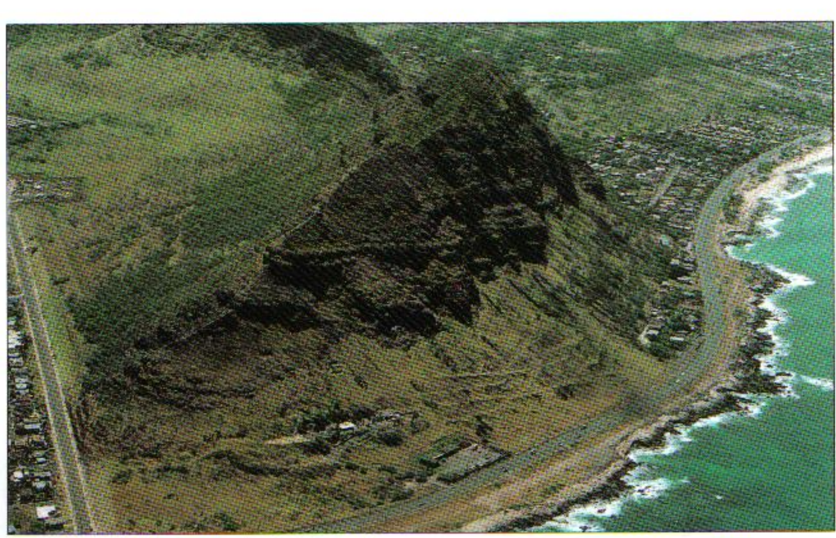
Postwar changes and developments

Much of the engineering work for new defenses and support structures began to slow as World War II moved to its conclusion. The entire US Coast Artillery service entered a period of decline after the war: the obvious lack of immediate naval threats and changes in technology contributed to the elimination of the service. In the age of amphibious and air warfare the concept of defending harbors with fixed guns became unrealistic. The overall drawdown of American service forces had considerable impact on the fixed defenses of Oahu. The Coast Artillery batteries quickly went into a reduced state at the conclusion of the conflict. A postwar study conducted in June 1945 advocated finishing the casemates at Hatch and Closson, but canceling work on the incomplete intermediate batteries.

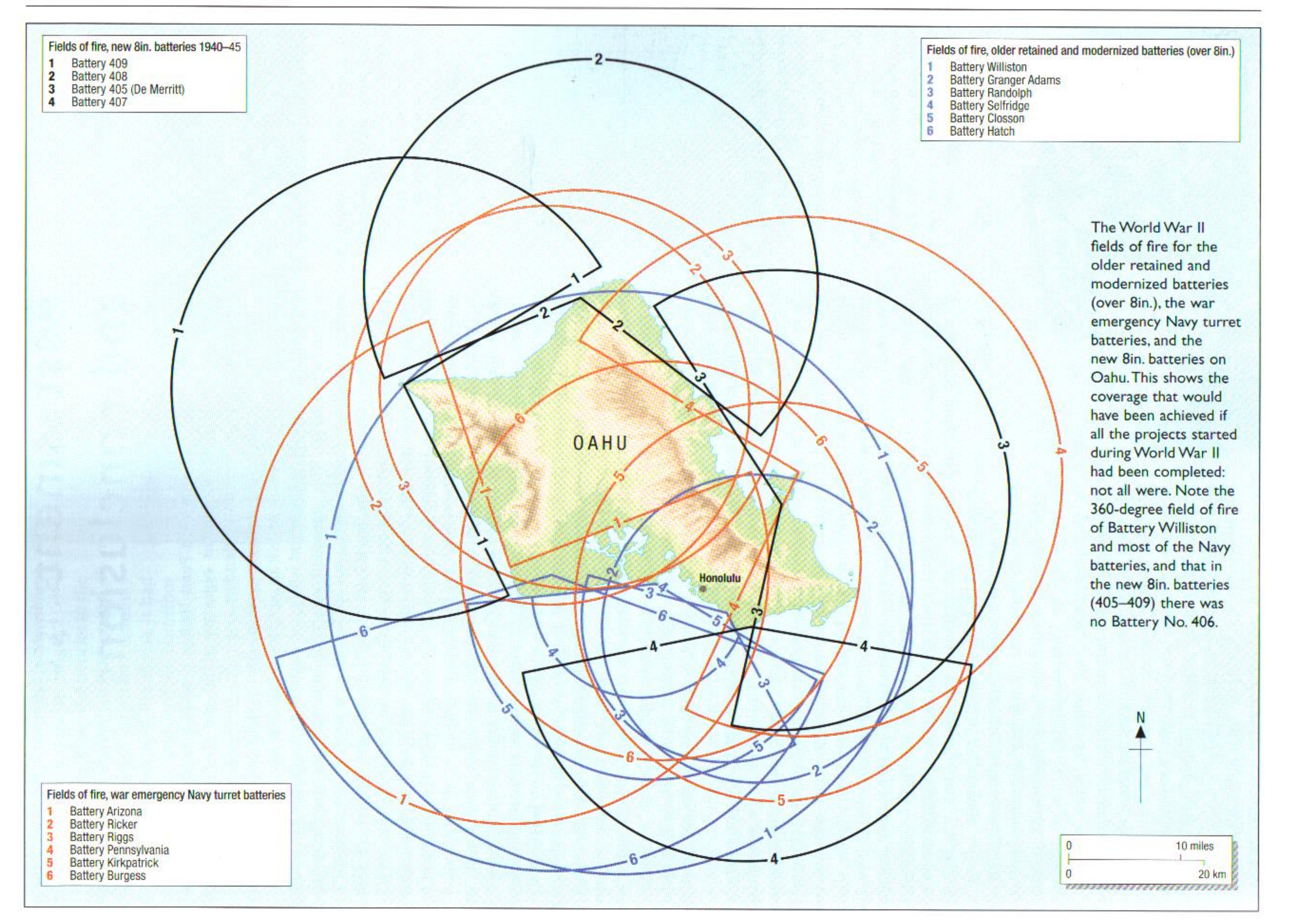
One of the critical problems encountered even before the end of the war was a lack of manpower. Coast Artillery units were critically short of personnel to man all the existing batteries and lack of skilled labor made the completion of new construction very difficult. This led to the rapid disarmament of older batteries late in the war, including Birkhimer, Harlow, Hasbrouck, Jackson, and Randolph. Soon the rapid-fire 3in. and 90mm batteries were being removed, and all of the remaining fixed seacoast guns were cut up for scrap between 1948 and 1950. The Army decided in 1950 to eliminate the Coast Artillery Corps itself and decommission all remaining coast defense batteries. Some of the better AA batteries lasted for several more years under the care of the field artillery. Oahu received four batteries for the Nike-Hercules AA missile in the late 1950s. They went into service in 1961, operated by the Hawaii Army National Guard. As the US Navy continued to maintain and upgrade its facilities at Pearl Harbor, the Army's defense role remained. Active Army garrison units were kept present on the island, and the now separate US Air Force has continued to maintain a strong presence of aircraft at its air bases. The postwar Pacific conflicts in Korea and Vietnam saw Oahu play an important staging and training role, even if remote from the possibility of direct attack.

BELOW Kaneohe Bay Naval Air Station just days after the Japanese attack. This photograph taken on December 9, 1941 shows a variety of damage to buildings and aircraft. Due to the limited availability of aircraft and crew, no long-range searches were being conducted on the morning of the attack. (NARA)





RIGHT The Puu-O-Hulu Military Reservation was first established in 1923 to site a series of fire control stations on its ridge line. Immediately after the Pearl Harbor attack an emergency battery of two 7in. guns was constructed near its base (in the lower left of this 1994 photograph). Eventually the casemates were used as part of Battery No. 303 for two 6in. guns, forming part of the permanent system of defenses. A series of tunnels was driven into the slopes to provide for magazines, generators, and support rooms. This final version of the emplacement was never completed. (TM)



The World War II fields of fire for the older retained and modernized batteries (over 8in.), the war emergency Navy turret batteries, and the new 8in. batteries on Oahu. This shows the coverage that would have been achieved if all the projects started during World War II had been completed: not all were. Note the 360-degree field of fire of Battery Williston and most of the Navy batteries, and that in the new 8in. batteries (405–409) there was no Battery No. 406.

Assessment and conclusions

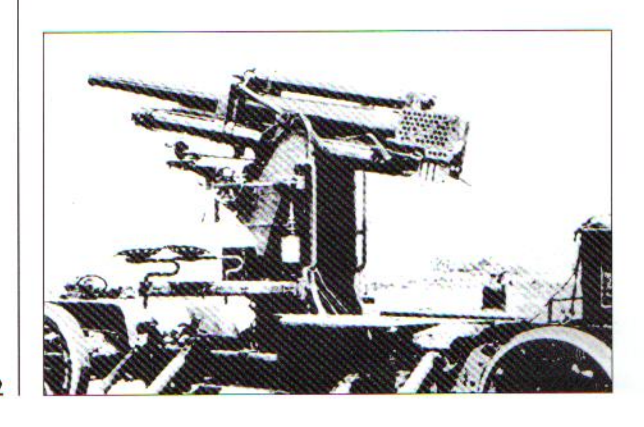
The Japanese surprise attack on Pearl Harbor is such a prominent historical event that it is hard to remain objective about the true capabilities and performance of the American defenders.

It is hard to criticize the strategic necessity for the defense. Pearl Harbor was clearly the most important American military outpost in the Pacific, and one close enough to the West Coast and with good enough harbor facilities to warrant a proactive defense. This statement does not hold true for the Philippines, which were much further away (and thus harder to supply) and destined for eventual independence. The naval base at Pearl Harbor and airfields on Oahu were necessary for sustained operations in the eastern Pacific and for advance launching of any cross-Pacific expeditionary force. Hawaii played a key role, along with Alaska and the Panama Canal Zone, in providing a defensive perimeter for the continental United States from any Pacific aggression.

The US Army put much time and effort into analyzing both the nature of potential threats and how to defend Oahu against them. Beginning in the 1920s a concerted effort was made to prepare annual department defense projects under the guidance of the Army's expanded War Plans Division. The Hawaiian Department produced a series of documents outlining potential enemy capabilities, plans for deployment, and contingency reactions. Periodically these were developed jointly with Navy counterparts. As an example of threat assessment, the December 1940 Defense Project listed six potential types of attack in order of priority: submarine, using torpedoes or mines; sabotage; a disguised merchant ship raid; a carrier-based air raid; surface ship raids; and a major combined attack. To some extent, the US Army planners tried to prepare for all of these alternatives.

The island of Oahu was well provided with and served by conventional seacoast artillery defense at the time of the attack. While some of the equipment was out of date by 1941, it was all well maintained and served by well-trained crews. The four 16in. guns were among the most powerful weapons in the world, and the American fire control system arguably one of the most accurate. An attack by Japanese raiding warships or by bombardment from capital ships would have been roughly received. Likewise an attempted landing in force would have had to overcome the coast defenses and then two relatively well-armed and trained infantry divisions manning considerable beach and field fortifications. While the Japanese proved capable of overpowering similar Allied ground forces in the Philippines and Malaya, they achieved this by avoiding the seacoast defenses and by gaining clear air superiority.

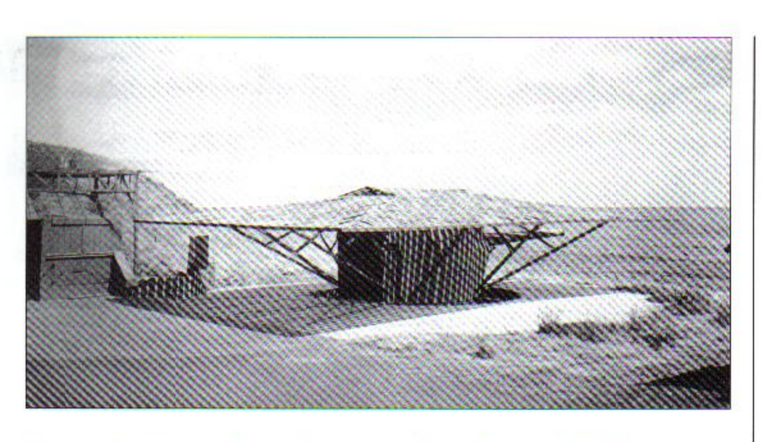
Prior to World War II the Army used two types of standard heavy anti-aircraft gun. The mobile 3in. m1918 gun (shown below) and the fixed emplacement 3in. m1917 gun had broadly similar performance characteristics. Both were shown to be inadequate for modern warfare – and were soon replaced throughout the service by more capable weapons. (AM)



The American military's preoccupation with potential sabotage or disruption by the local Japanese–American population did contribute to the disaster. As it turned out there was no locally organized action or disloyalty by this population, and while for some sympathies and emotions were mixed, most demonstrated staunch and even active military support for the United States. Still the Army, and to a lesser extent the Navy, interpreted the war warnings from Washington in the final days prior to the attack as a call to issue Alert Level One – active precautions against sabotage. Consequently aircraft were concentrated on their airfields rather than being dispersed, and ammunition remained locked in

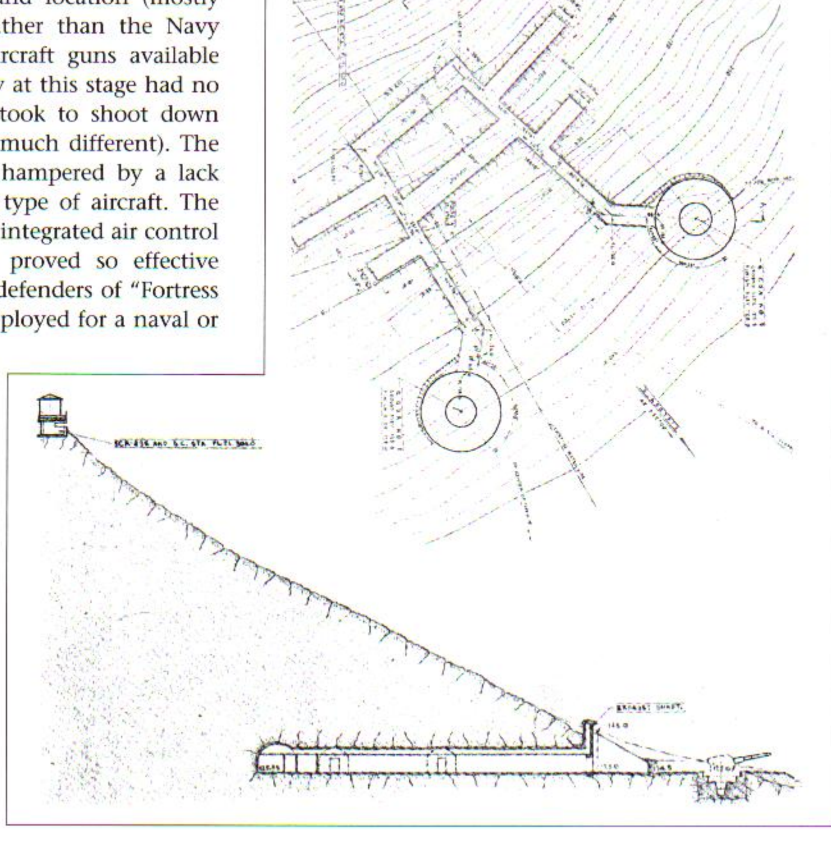
magazines – both actions that hindered the defense against a surprise air attack.

There were significant deficiencies in the American preparations to defend against a thoroughly executed air attack. Certainly the Army were aware of this threat: it had been successfully practiced in numerous annual exercises, it was listed as one of the six potential types of attacks, and it was well known that the British had attacked the Italian Navy in their base at Taranto the previous year. What was not appreciated was the daring and ability of the Japanese Navy and the inadequacy of the defensive measures put in place. These factors combined to result in a military disaster rather than a successful defense, or even a costly victory.



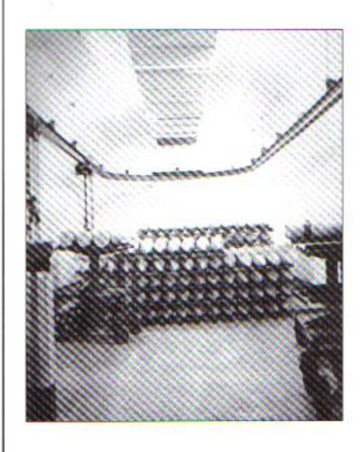
One of the new 1940 Program gun batteries defending Kaneohe Bay. This is one of the two 6in. guns at Fort Hase enclosed in a 4in.-thick cast steel shield, disguised with overhead camouflage. This photo is dated March 22, 1945. (NARA)

Certainly credit should be paid to the Japanese Navy in their planning and execution of the attack. To some extent their own capability was only realized in the previous year prior to December 7, and it is clear that the Americans did not observe these developments. Chief among these were the availability of six carrier air groups, and special development of shallow-water torpedo techniques that caught the Americans unaware. As previously discussed, the American defense was only optimized if the enemy attacking fleet was discovered on its approach. The lack of a viable air-reconnaissance force by either the Army or Navy meant that this could not be accomplished, and that the enemy arrived unannounced. The fact that the approaching Japanese aircraft were misidentified by radar is one of the real ironies of the events. Finally the equipment emplaced to counter a major air attack was woefully inadequate. The type, number, and location (mostly around seacoast artillery forts rather than the Navy Yard or even airfields) of anti-aircraft guns available were clearly insufficient: the Army at this stage had no realistic appreciation of what it took to shoot down attackers (and the Navy was not much different). The air intercept capability was also hampered by a lack of numbers, by surprise, and by type of aircraft. The Americans had not developed the integrated air control and coordination methods that proved so effective later in the war. Simply said, the defenders of "Fortress Oahu" were well equipped and deployed for a naval or amphibious landing in 1941, but their defenses against an air attack failed to keep up with the magnitude of the aerial assault that the Japanese delivered on December 7, 1941: They therefore failed in their primary mission.

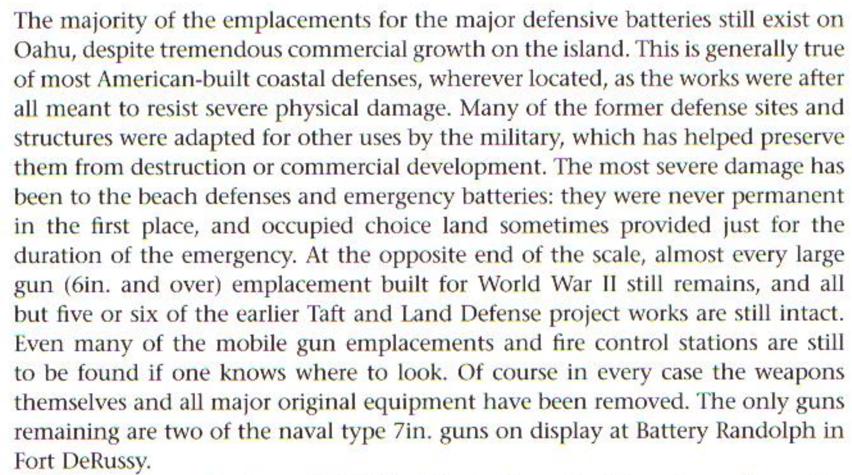


The original project design for Battery No. 405 at Kaneohe Bay. It was armed with two 8in. guns, and built by tunneling into the hillside. The final design angled the side rooms off the main corridors, mainly to accommodate the type of boring equipment available. (NARA)

The sites today



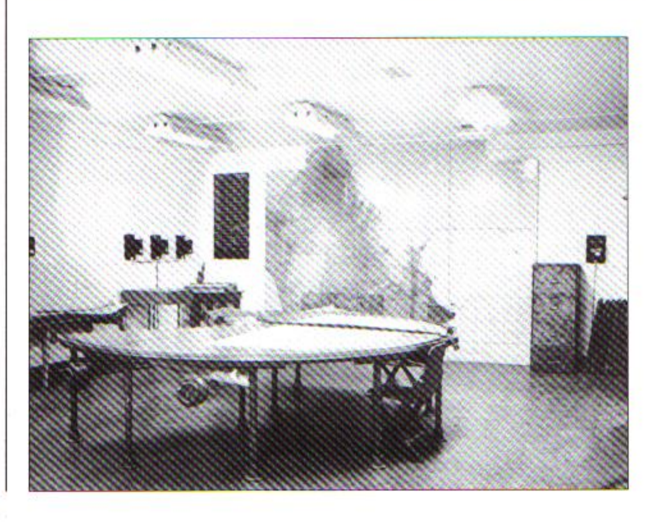
The projectile room of Battery No. 405, Kaneohe Bay in 1945, showing stacked projectiles and handling equipment. The battery featured a traverse magazine for powder and projectiles. (NARA)



The majority of the emplacements for the major defensive batteries still exist on Oahu, despite tremendous commercial growth on the island. This is generally true of most American-built coastal defenses, wherever located, as the works were after all meant to resist severe physical damage. Many of the former defense sites and structures were adapted for other uses by the military, which has helped preserve them from destruction or commercial development. The most severe damage has been to the beach defenses and emergency batteries: they were never permanent in the first place, and occupied choice land sometimes provided just for the duration of the emergency. At the opposite end of the scale, almost every large gun (6in. and over) emplacement built for World War II still remains, and all but five or six of the earlier Taft and Land Defense project works are still intact. Even many of the mobile gun emplacements and fire control stations are still to be found if one knows where to look. Of course in every case the weapons themselves and all major original equipment have been removed. The only guns remaining are two of the naval type 7in. guns on display at Battery Randolph in Fort DeRussy.

There are several real practical difficulties for the potential explorer. The earlier forts have better documentation and are easier to locate than the multitude of small later reservations from World War II. Starting in the 1920s, the fortification positions tended to be more dispersed. They are simply not as easy to find, even if they exist. They are not indicated on current-day maps; and the maps from historical and government archival record groups are usually not detailed enough to indicate precise positions. All except the largest of the permanent batteries are by their nature very difficult to see from a ground inspection – and this is an island with high rainfall and abundant native growth. Others, like fire control stations, were designed on purpose to blend into local conditions and remain obscure. While many of the original parcels of land (forts, reservations, etc.) are still held by a government agency, the type and authority of these agencies varies considerably. Many sites require advance permission and arrangements to see, sometimes even requiring an escort for the duration of the visit. Sites now exist on US Army, Air Force, Navy, Marine, Hawaiian National Guard, federal agency, state, city jurisdiction, as well as private land. Even finding the name and address of the appropriate authority can be at times a daunting task.

A battery plotting room in the Kaneohe Bay defenses in a photo taken March 22, 1945. The room was proofed against attack by gas and chemical weapons. The focus of the room was the plotting board, a large semicircular table with mechanical arms and pre-positioned stations, which facilitated the calculation of range coordinates. Note the large Oahu map on the rear wall. (NARA)



Of the original Taft-era forts, all except Fort Armstrong still exist as military reservations. Fort Kamehameha was eventually taken over by adjacent Hickam Air Force Base. Except for batteries Barri and Chandler (destroyed in the early 1960s), the major emplacements still exist, though several are actively used by base personnel and have severely restricted access. Fort DeRussy is today an open Army post, and former Battery Randolph is the home to the US Army Museum of Hawaii. The battery was damaged by attempts to destroy it in the 1960s, and all of its earth cover has been removed, but the museum has many exhibits on the defense of Oahu, and several of the magazine rooms have been restored for display. Unfortunately adjacent Battery Dudley was destroyed, and no traces of it exist. Most of the original base buildings have also gone. Fort DeRussy

is probably the easiest site to access for the casual visitor. Fort Ruger at Diamond Head Crater now has divided ownership, though much is controlled by the Hawaiian National Guard. There is a public park located inside the crater, with trails that are open during daylight hours (like the one leading to the outstanding fire control complex at Leahi Peak).

The former Land Defense batteries have not fared as well. Ford Island has gone through much development in the past ten years at the Pearl Harbor Naval Station. While it appears that the two Armstrong 6in. batteries exist, close access is not possible. As mentioned earlier, batteries Barri and Chandler were destroyed at Bishop's Point postwar. At Fort Ruger batteries Dodge, Hulings, and the 6pdr emplacements still exist, but on a road normally closed to visitors. Black Point, home for both Battery S.C. Mills and Granger Adams is all private residence property now, and no visible remains of either battery exist.

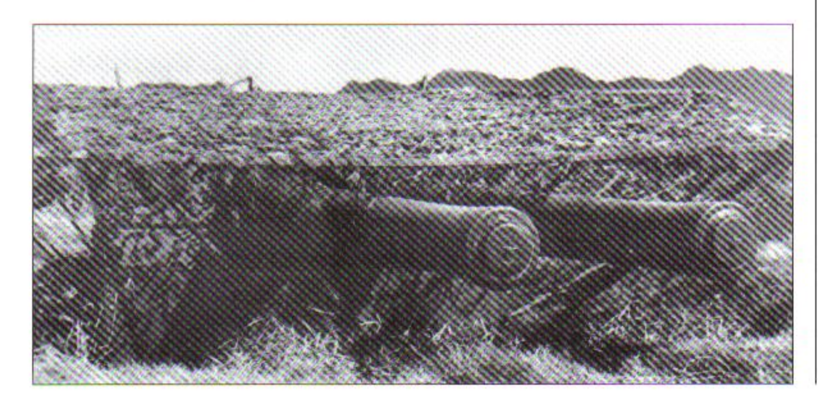


The change of command ceremony: Hawaiian Department Commander Gen. Delos Emmons (far left) hands over to Gen. Robert Richardson (second from left) in June 1943. Richardson served out the war in this role. Emmons had succeeded Gen. Walter Short, who was relieved of command on December 17, 1941. (UH)

The two reservations for the 16in. batteries built between the wars still exist. Fort Weaver is now a naval housing area, but may soon be turned over to private hands for redevelopment. The open gun blocks for the two rifles have been either buried or built over for housing. However the protected switchboard and battery commander's station do still exist. Fort Barrette remains as the City and County of Honolulu Kapolei Regional Park. The large casemated gun houses and the combined protected switchboard and power room exist on park land, though at times the park has limited access hours.

The status of World War II structures also varies tremendously by location. The site of Puu-O-Hulu (Battery number 303 and the previous 7in. battery) is the Maili Point Oahu Civil Defense Agency structure, and accessible only by arrangement. The Battery Arizona site (former Kahe Point Military Reservation) is now operated as part of the Waimanalo Gulch Sanitary Landfill by the City of Honolulu. All of the underground rooms and magazines exist, as does the barbette up to the surface. Of course the turret and the guns were scrapped after the war, as were the generators and other major internal parts. Again, special arrangements are needed in advance to gain access. Sand Island is now a public park, and structural remains of Battery Harbor's 7in. guns have been turned into a playground. At the National Memorial Cemetery administered by the Department of Veteran's Affairs at Punchbowl is the uncompleted Battery number 304. While used for storage by the cemetery, the exterior portals can be viewed. The uncompleted 8in. Battery number 407 at Fort Ruger can be viewed from the road around Diamond Head to the south.

All of the Kaneohe Bay major battery sites remain. Fort Hase is now operated as the US Marine Corps Base, Hawaii, Kaneohe Bay. The site of Battery Pennsylvania is mostly intact, but as it abuts the end of the Marine rifle range, access is possible only at certain times by advance arrangement. Battery French is in the base housing area, and also has controlled access. The other two major batteries of the defenses are



One of the mounts of Battery Kirkpatrick at Wiliwilinui Ridge. This is one of the few known photographs showing the dual 8in. gun mounts emplaced on Oahu in 1942. The mounts (strictly speaking they were not turrets, though the Army used the term interchangeably with "mount") were pretty much the only above-ground part of the structure: the other important rooms and magazines were underground. (NARA)

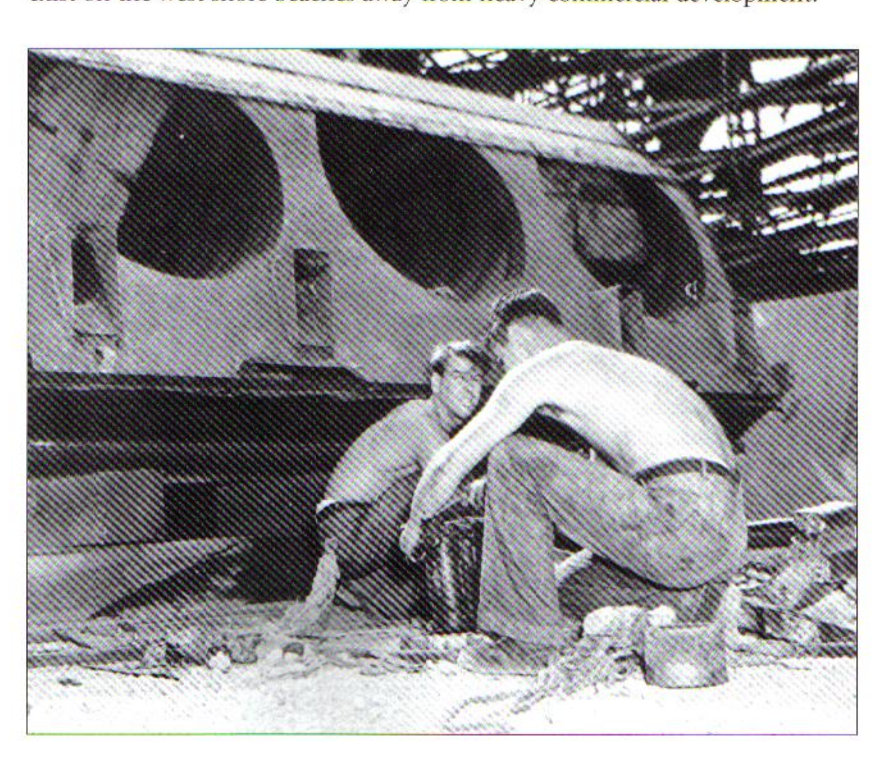


A 1994 photograph of one of the gun positions of Battery Kirkpatrick. The dual 8in./55cal. naval gun mount would have been emplaced on this base ring. (TM)

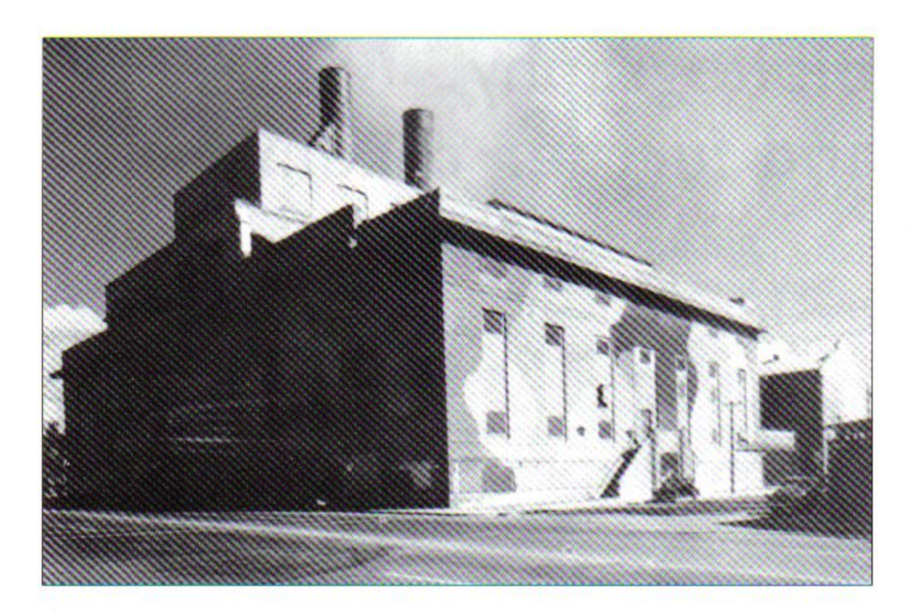
now on private property. Battery DeMerritt is privately owned (and once used for mushroom cultivation), and Battery Cooper is on Kualoa Ranch property. Access is only possible through their owners, although Cooper's casemates can be viewed at a distance. One of the positions for the 8in. railway mount at Kahuku is visible near the clubhouse for a golf course now at this location, as are the incomplete tunnels for what was to become Battery number 409 at Kaena Point.

The 8in. naval turret batteries are not generally accessible to present-day visitors. The location at Salt Lake has been completely developed for private residences. There is no sign of the battery above ground, and it is not known if anything still exists or is buried underground. The other three sites are also privately owned and not available for public access. Wiliwilinui Ridge was also developed for homes, Brodie Camp has recently been buried, and Opaeula has heavily collapsed and been partially buried.

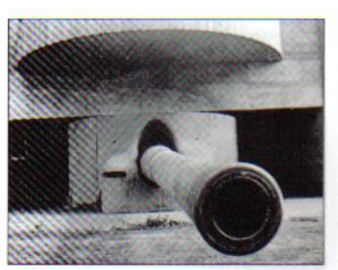
Fort Shafter, Hickam Air Force Base's Fort Kamehameha section, and Schofield Barracks have numerous buildings that date back to the war or previous assignments. Many of the large tunnel complexes built just prior to and during the war also still exist, though in many cases only the entry portals can be viewed as they are either sealed or still in use. The Aliamanu Crater collection of tunnels, the Kunia Tunnel, and the shorter command post tunnels at Fort Ruger all still exist and can be viewed by drive-bys. Fire control stations still exist at many locations, besides Leahi Peak described earlier, particularly in the southwest and southeast peaks of Oahu. Likewise the best remaining beach defense pillboxes exist on the west shore beaches away from heavy commercial development.



This photograph taken February 26, 1945 shows Pearl Harbor Navy Yard workers preparing one of the triple 14in. gun turrets from the USS *Arizona*, just a few months before erection of the turret in its permanent coast artillery location. (NARA)



Many important municipal structures were camouflaged in the period following the December 1941 attack. While some schemes were quite elaborate, most were simple painting jobs – such as the Hawaiian Electric powerhouse on the waterfront in Honolulu shown here. (UH)



ABOVE Two large batteries, Battery Closson and Battery Hatch, received massive overhead protection ("casemating") just as war broke out. Battery Hatch is pictured here in 1946 with its concrete casemate and new steel gun shield. (AM)

LEFT When disarmament came, most of the *matériel* was scrapped locally. This picture (probably from early 1947) shows one of the 14in. disappearing guns of Battery Randolph cut into pieces prior to being removed. (AM)

Bibliography and further reading

The ordnance storage tunnels at Aliamanu Crater today. This area was extensively tunneled in the 1930s and 1940s for a variety of command posts and storage depots: many of the entry portals can be seen from the roads crossing this area today. (GW)

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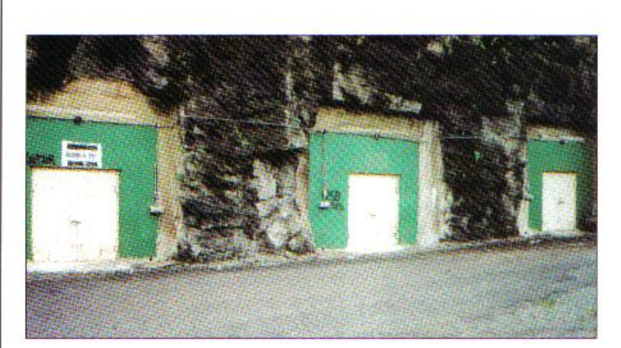
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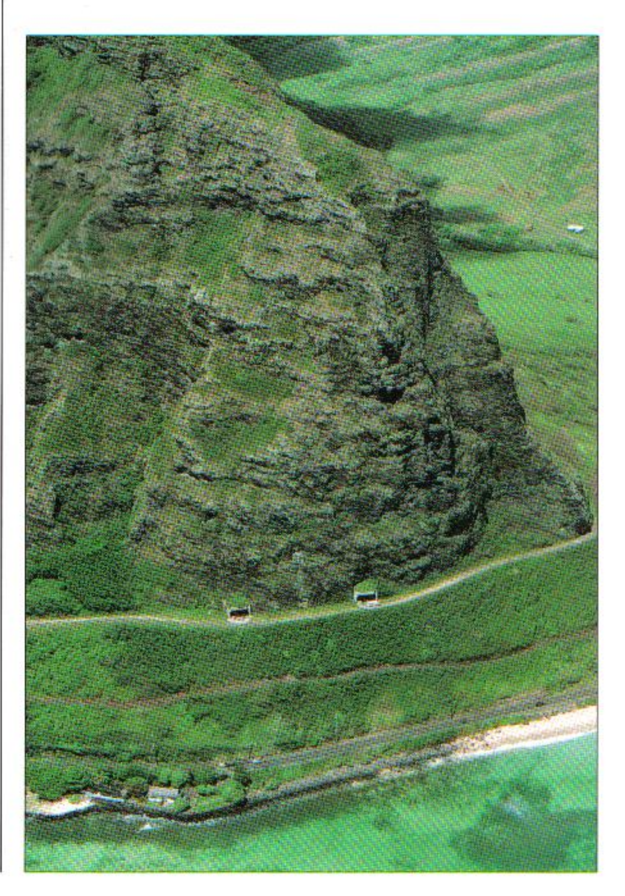
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Additionally the Coast Defense Study Group has photocopy reprints available of various reports of completed works and conference tour notes pertinent to the defenses of Honolulu and Pearl Harbor. Visit www.cdsg.org or send mail to Coast Defense Study Group, 634 Silver Dawn Ct, Zionsville IN 46077, USA.



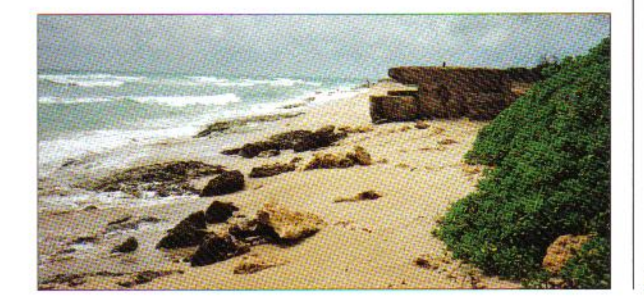
The cliffs of Lae-o-Ka-Oio Point dominate the gun casemates and battery commander's station of Battery Avery J. Cooper. The magazine and operational tunnels to support the two 6in. guns on barbette carriages have been driven into the cliffs. A 75ft shaft connects the combined commander/radar station to the magazine level below. (TM)

Appendix

Coastal artillery seacoast cannons on Oahu 1907–50

Coastal artillery seacoast cannons on Oahu 1907–50				
Gun size	**Model**	**Usual carriage/mount**	**Projectile weight (lbs)**	**Maximum range (yds)**
2.24in.	1900	m1900 carriage	6	6,241
3in.	1903	m1903 pedestal	15	11,100
90mm	M1A1	M3 carriage	23	19,500
4in.	Navy Mk IX	Naval pedestal mount	33	15,920
4.72in.	Armstrong	Armstrong pedestal mount	45	11,110
5in.	1900	m1903 barbette mount	58	10,431
6in.	Armstrong	Armstrong pedestal mount	106	10,185
6in.	1908/1908M1	m1905 disappearing carriage	106	14,600
6in.	1903 or 1908/1908M1	MI barbette carriage	106	27,100
155mm	1918M1	m1918M3 wheeled carriage	96	17,400
7in.	Navy Mk II	Naval pedestal mount	165	16,900
8in.	1888	m1918 railway carriage	260	21,000
8in.	Navy Mk VI	M1 barbette carriage	260	35,300
8in.	Navy Mk IX	Dual ship "turret"	260	31,860
240mm	1918	Wheeled carriage	345	16,300
12in.	1895M1	m1901 disappearing carriage	1,046	17,000
12in.	1895M1	m1917 long-range barbette carriage	1,046	29,300
12in.	Mortar m1890MI	m1896MIII carriage	840–1,046	15,300
12in.	Mortar m1908	m1908 carriage	840–1,046	15,300
12in.	Mortar m1890MI	m1918 railway carriage	840–1,046	15,300
14in.	1907	m1907MI disappearing carriage	1,660	21,350
14in.	Navy Mk 8	Triple turret	1,500	34,300
16in.	1919	m1919 carriage	2,340	49,140
16in.	Navy Mk II	M4 carriage	2,240	44,680

Sources:
Table of United States Army Cannon, Carriages & Projectiles, 1918 and 1924 revisions.
Seacoast Artillery Weapons, War Department Technical Manual TM 4-210



World War II pillbox on an Oahu beach. Due to commercial development, many of the pillboxes no longer exist. Those that survive are on the southwestern and western shores. (GW)

Fixed artillery defenses of Oahu 1907–50

Original coast artillery reservations 1907–15					
Fort/reservation	**Battery**	**Armament**	**Year entered service**	**Current status**	**Notes**
Fort Kamehameha	Closson	2x12in. long-range guns	1920	Exists	1
	Selfridge	2x12in. disappearing guns	1913	Exists	
	Hasbrouck	8x12in. m1908 mortars	1914	Exists	
	Jackson	2x6in. disappearing guns	1914	Exists	
	Barri	2x4.72in. Armstrong guns	1915	Gone	
	Chandler	2x3in. on pedestal mounts	1915	Gone	
	Hawkins	2x3in. on pedestal mounts	1914	Exists	
	AMTB (anti-motor-torpedo boat)	2x90mm AMTB	1943	n/a	
Ford Island Military Reservation	Adair	2x6in. on Armstrong pedestals	1917	Exists	2
	Boyd	2x6in. on Armstrong pedestals	1917	Exists	
Fort Armstrong	Tiernon	2x3in. on pedestal mounts	1911	Gone	
Fort DeRussy	Randolph	2x14in. disappearing guns	1913	Exists	3
	Dudley	2x6in. disappearing guns	1913	Gone	
	Waikiki	2x90mm AMTB guns	1943	Gone	
Fort Ruger	Harlow	8x12in. m1890M1 mortars	1910	Exists	
	Birkhimer	4x12in. m1890M1 mortars	1917	Exists	4
	Dodge	2x4.72in. on Armstrong pedestals	1915	Exists	5
	Hulings	2x4.72in. on Armstrong pedestals	1915	Exists	
	(unnamed)	12x6pdr guns on field carriages	1915	Exists	
	Battery 407	2x8in. on casemated barbette carriages	Work suspended 1945	Exists	
	S.C. Mills	2x5in. guns on pedestals	1916	Gone	
	Granger Adams	2x8in. on railway barbette carriages	1935	Gone	

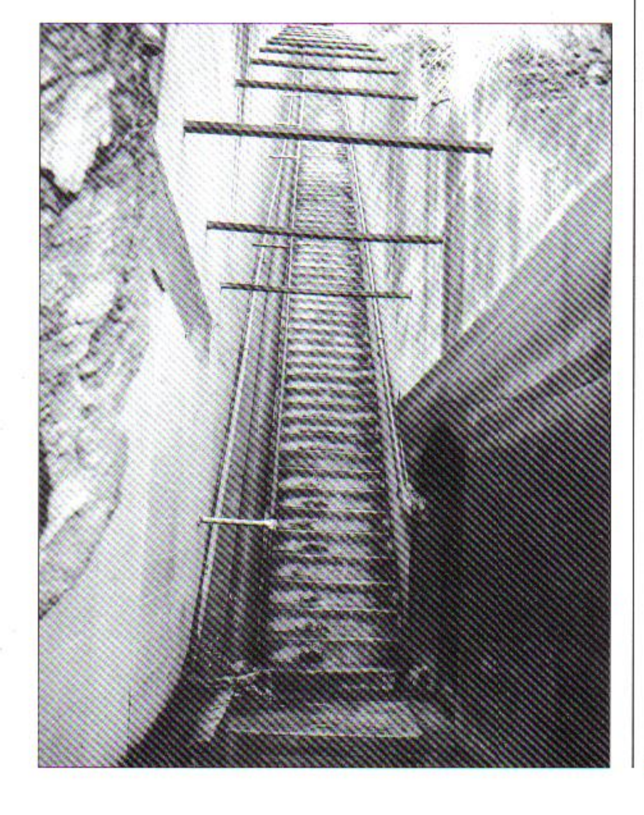
New coast artillery reservations 1922–40					
Fort/reservation	**Battery**	**Armament**	**Year entered service**	**Current status**	**Notes**
Fort Weaver	Williston	2x16in. Army guns on barbette carriages	1924	Gone	6
	AMTB (anti-motor-torpedo boat)	2x90mm AMTB	1943	n/a	
Fort Barrette	Hatch	2x16in. Navy guns on barbette carriages	1935	Exists	7

World War II reservations for permanent fixed defenses 1941–48

Fort/reservation	Battery	Armament	Year entered service	Current status	Notes
Sand Island	Sand Island	2x90mm AMTB	1943	n/a	
Salt Lake	Burgess	4x8in. mounted in two Saratoga turrets	1942	Gone	
Punchbowl	Battery 304	2x6in. guns, barbette carriages	Work suspended 1945	Exists	
Wiliwilinui Ridge	Kirkpatrick	4x8in. mounted in two Lexington turrets	1942	Exists	
Koko Saddle	Battery 305	2x6in. guns, barbette carriages	Never started	n/a	
Fort Hase	Pennsylvania	3x14in. Navy guns in a triple turret	1945	Exists	
	DeMerritt	2x8in. guns, barbette carriages	1943	Exists	
	Sylvester	4x8in. guns, railway barbette carriages	1942	Gone	
	French	2x6in. guns, barbette carriages	1943	Exists	
	Pyramid Rock	2x90mm AMTB guns	1943	n/a	
Lae-o-Ka-Oio	Cooper	2x6in. guns, barbette carriages	1943	Exists	
	Kaoio	2x90mm AMTB guns	1943	Gone	
Kahuku	Kahuku	4x8in. guns, railway barbette carriages	1942	One still exists	
Waialee	Battery 408	2x8in. guns, barbette carriages	Never started	n/a	
Brodie Camp	Ricker	4x8in. guns in two turrets	1942	Gone	
Opaeula	Riggs	4x8in.guns in two turrets	1942	Exists	
Kaena Point	Battery 409	2x8in. guns, barbette carriages	Work suspended 1945	Exists	
Puu-O-Hulu	Battery 303	2x6in. guns, barbette carriages	Work suspended 1945	Exists	8
Kahe Point	Arizona	3x14in. Navy guns in a triple turret	Work suspended 1945	Exists	

Notes

1 Casemates added 1942–43
2 Mostly buried under officers' quarters
3 Now the location of the US Army Museum of the Pacific
4 Mortar positions changed in 1921
5 Modified for 4in. naval gun in 1942
6 Gun blocks buried, some other structures remain
7 Casemates added 1942–43
8 Utilized location of temporary 7in. gun battery Battery Hulu



Leahi Peak is the highest point on Diamond Head Crater, and was a natural choice for placing fire control equipment. These are the "99 stairs" built to connect the trail from the crater bottom to the stations. There is now a public park on the military reservation, and visitors can climb these steps. (GW)

Locations of fixed emplacements for mobile guns 1927–46

Model 1920 240mm howitzers (12 total available on Oahu 1922–46)

1927–32

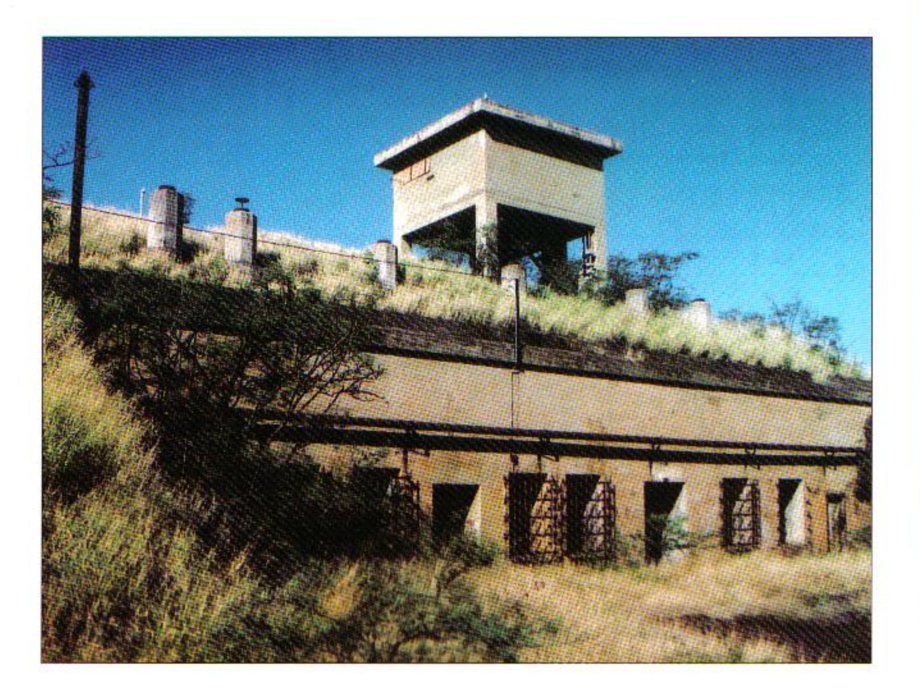
- 1 emplacement at Kaaawa near Kahana
- 2 emplacements at Laie
- 3 emplacements at Makua
- 2 emplacements at Pupukea
- 2 emplacements at Ulupau Head
- 2 emplacements at Waimanalo

1939–41

- 2 emplacements at Kalihi
- 2 emplacements at Kolekole
- 2 emplacements at Kunia
- 2 emplacements at Quadrupod

Model 1918 155mm guns (circular emplacements known as "Panama mounts"). Forty-eight gun emplacements were authorized in 1932, with additional emplacements added in 1940 and 1942. The known locations are:

- Aliamanu (4)
- Ashley Station, Fort Schofield (4)
- Awanui (4)
- Barbers Point (4)
- East (4)
- Ewa (4)
- Fort Kamehameha (4)
- Fort Ruger (4)
- Fort Weaver (4)
- Homestead (3) – on 5in. gunblocks
- Kahe (4)
- Kawailoa (4)
- Koko Head (4)
- Loko (3)
- Mokuleia (4)
- Oneula Point (4)
- Puu Palailai (4)
- Pine (4)
- Punchbowl (4)
- Pupukea (4)
- Pyamid Rock (4) – Fort Hase
- Ranch (4)
- Roundtop (4)
- Sand Island (4)
- School (4)
- Waimanalo Camp (4)
- Waimea (4)
- Willy (4) – Wiliwilinui Ridge
- X-ray (4)

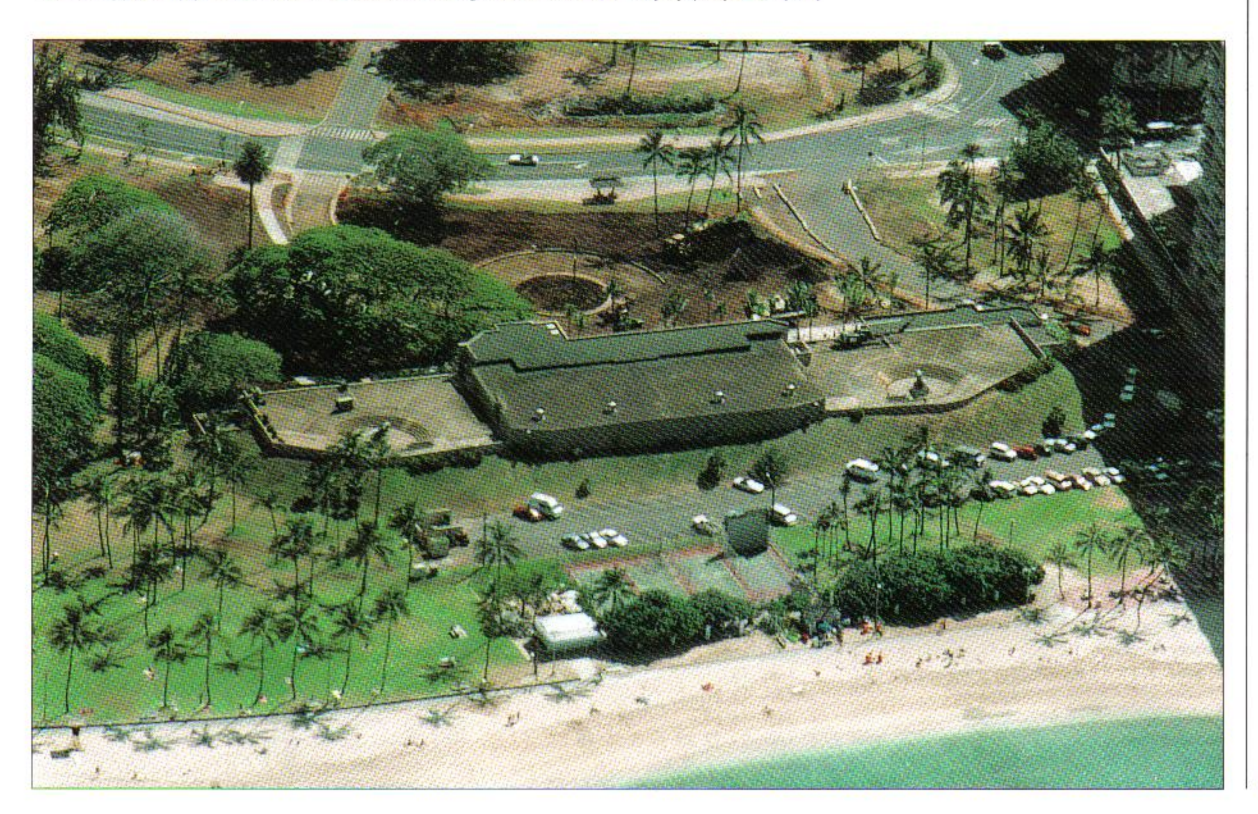


The protected switchboard and plotting room for Battery Hatch, Fort Barrette. It was completed in 1935, and modified during the war. The structure is intact and can be visited at the Kapolei Regional Park. (GW)

Locations of temporary batteries 1941–45

Type	Location	Battery	Armament	Notes
7in. ex-Navy guns (13 in total in Army possession)	Sand Island	Battery Harbor	4x7in.	
	Puu-O-Hulu	Battery Hulu	2x7in.	Site intended for Battery 303
5in. ex-Navy guns (final disposition)	Ahua Point, Fort Kamehameha	Battery Ahua	2x5in. guns	
	Kahana Bay	Battery Kahana	3x5in. guns	
	Makua Point	Battery Homestead	3x5in. guns	Later converted to 155mm
	Nanakuli	Battery Nanakuli	3x5in. guns	
	Oneula	Battery Oneula	2x5in. guns	
4in. ex-Navy guns	Fort Ruger	Battery Dodge	2x4in. guns	In old 4.72in. casemates
	Kaena Point	Battery Kaena	2x4in. guns	
	Kalihi	Battery Kalihi	3x4in. guns	
	Mokuleia	Battery Dillingham	2x4in. guns	
	Kaneohe Bay	Battery Kaneohe	2x4in. guns	
3in. guns	Fort Hase	Battery Kii	2x3in. Navy guns	South side of Ulupau
		Battery Puka	3x3in. Navy guns	North side of Ulupau
	Wailea Point	Battery Wailea	2x3in. Navy guns	ex-Battery Chandler, Fort Kamehameha

The former Battery Randolph at Fort DeRussy is now the US Army Museum of the Pacific. After discovering how difficult the reinforced concrete structure was to destroy, the Army opted to adapt the site and locate its museum there. This 1994 image shows the two emplacements for 14in. disappearing guns, which now have naval 7in. guns set there for display purposes. (TM)



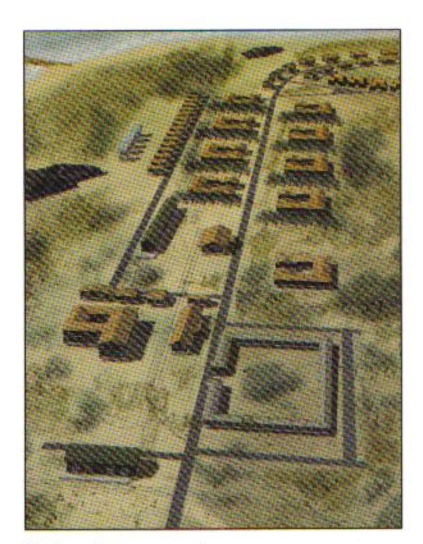
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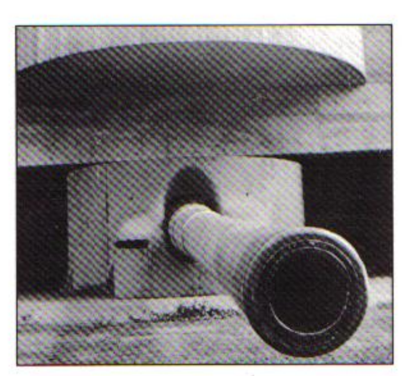
Fortress • 8

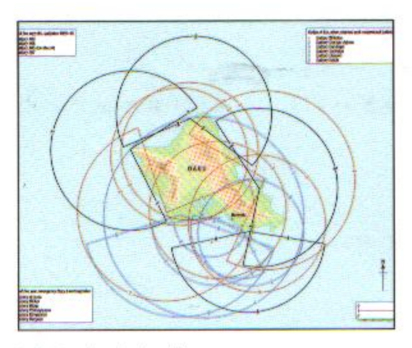
Design, technology and history of key fortresses, strategic positions and defensive systems

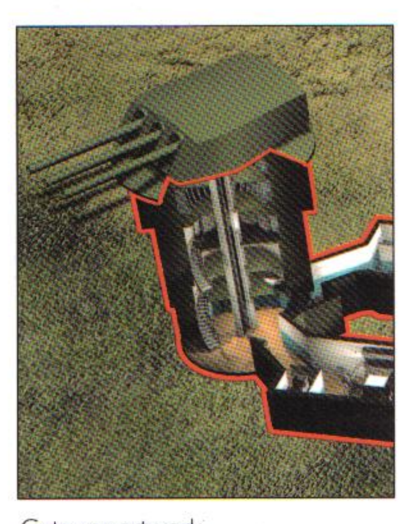
Defenses of Pearl Harbor and Oahu 1907–50

At the beginning of the 20th century, the military importance of the Hawaiian Islands became clear. Oahu in particular was a key bastion in projecting America's military power in the Pacific. The island was turned into a military fortress – and yet it also became the site of one of America's greatest defensive failures, the Japanese attack of December 7, 1941. By the end of World War II, the harbor itself was the most heavily defended in the world, and the island had earned the sobriquet "Fortress Oahu." This title documents the development of the coastal, air and land defense systems that served to protect Pearl Harbor and Honolulu from 1907 to 1950, and seeks to understand why these failed at a critical point.


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